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Household Food Security in the United States in 1995

Executive Summary

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Household Food Security in the United States in 1995

Executive Summary

September 1997

Prepared for:

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EXECUTIVE SUMMARY

In Aprii 1995, the U.S. Bureau of the Census conducted the first Food Security Supplement to its regular Current Population Survey (CPS). With about **45,000** household interviews, the Food Security Supplement provides the basis for. the **first** comprehensive measurement of food insecurity and hunger in a nationally-representative sample of U.S. households. This survey is the cornerstone of the food security measurement project begun in 1992 to carry out a key task assigned by the Ten-Year Comprehensive Plan for the National Nutrition Monitoring and Related Research Program (NNMRRP). The task is to develop a standard measure of food insecurity and hunger for the United States, for use at national, state, and local levels.

This project has been a cooperative undertaking by the responsible federal government agencies under the leadership of the Food and Consumer Service (FCS) of the U. S. Department of Agriculture jointly with the National Center for Health Statistics/Centers for Disease Control and Prevention (NCHS) of the Department of Health and Human Services. Academic and other private-sector research experts in the field of food security and hunger measurement have aided the project from its beginning, achieving a substantial public/private partnership in the effort to develop a state-of-the-art food security survey questionnaire, statistical measurement method, and food insecurity and hunger measures and prevalence estimates for the nation.

The present study reports the first of these national prevalence estimates for food insecurity and hunger for the **12-month** period ending in April 1995, based on the CPS data and applying a sophisticated statistical measurement method that creates a detailed scale for measuring the underlying level of severity of food insecurity and hunger experienced in U.S. households. Based on this food security scale, a simpler measure is constructed that classifies households into several broad ranges or levels of severity, defining four categories of food security status for U.S. households:

- food secure,
- food insecure without hunger,
- food insecure with moderate hunger, and
- food insecure with severe hunger.

The categorical measure allows one to estimate the number of American households that experience food insecurity and hunger within each of the broad levels specified. The measure is designed to be useful primarily for monitoring changes in prevalence over time, and comparing prevalence across groups within the population, on a sustained, consistent basis.

Background and Definitions

Food security has been defined briefly as "assured access to enough food for an active, healthy life." The household should have access to enough food, the food should be nutritionally adequate, it should be safe, and the household should be able to obtain it through normal channels. Although all of these dimensions of food security are important, the measure presented here focuses on whether the household has "enough" food, as perceived and reported by adult members of the household. When food insecurity on this central dimension reaches severe levels, actual hunger for household members is the result.

Hunger is defined briefly as "the uneasy or painful sensation caused by a lack of food." The CPS Food Security Supplement aims to measure only that hunger which results from the financial resource constraint of the household-from being unable to afford enough food. The survey does not measure hunger that results from being too busy to eat, from voluntary fasting, from illness, or from any other cause except lack of financial resources. Thus, food insecurity and hunger measured here are clearly related to general income poverty. They focus, however, on only one area of household circumstances, rather than on the general problem of whether resources are adequate to cover all areas of need.

Interest in measuring food insecurity and hunger springs from two sources. First, food security is an important dimension of basic individual and family well-being, analogous to health or housing. Food insecurity and hunger are undesirable in their own right, and possible precursors to more serious health and developmental problems. Monitoring food security is important for understanding one fundamental component of the well-being of the American population and for identifying geographic or other subgroups with particularly undesirable and high-risk conditions.

Second, numerous public and private food assistance programs attempt to ameliorate food insecurity and hunger. Accurate measurement of food insecurity and hunger are important for program planners and policymakers to assess adequately the effectiveness of these programs

in meeting their intended objectives. This need for concrete indicators of program outcomes takes on new importance for federal agencies under the mandate of the 1993 Government Performance and Results Act (GPRA), which requires agencies to give increased, explicit attention to such indicators.

The government's food security measurement effort was built upon extensive private-sector research in the late 1980s that expanded and sharpened the understanding of food security, food insecurity, and hunger. This work led to the development by an expert working group of the American Institute of Nutrition of the following conceptual definitions, which were published by the Life Sciences Research Office (LSRO) of the Federation of American Societies for Experimental Biology (Anderson/AIN/LSRO, 1990):

- ***Food security*** — "Access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies). "

- ***Food insecurity*** — "Limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways. "

- ***Hunger*** — ***"The*** uneasy or painful sensation caused by a lack of food. The recurrent and involuntary lack of access to food. Hunger may produce malnutrition over time. ... Hunger ... is a potential, although not necessary, consequence of food insecurity. "

These definitions underlie the CPS Food Security Supplement and the new measurement scale discussed below, with the one additional qualification, already described, that only resource-constrained or poverty-linked food insecurity and hunger are intended to be captured by the measure.

The Food Security Scale

The Food Security Supplement contains a large battery of questions asking respondents about various aspects of food sufficiency in their households. Taken individually, none of these questions can provide a measure of the severity and extent of food insecurity or hunger. Taken together, a systematic set of 18 of the CPS questions (those with strong statistical properties

identified by the measurement method) do provide such a measure. The CPS questions ask about five general types of household food conditions, events, or behaviors:

- Anxiety that the household food budget or food supply may be insufficient to meet basic needs;
- Perceptions that the food eaten by household members was inadequate in quality or quantity;
- Reported instances of reduced food intake, or consequences of reduced food intake (such as,the physical sensation of hunger or reported weight loss) for adults in the household;
- Reported instances of reduced food intake or its consequences for children in the household; and
- Coping actions taken by the household to augment their food budget or food supply (such as borrowing from friends or family or getting food from emergency food pantries).

All of the CPS food security questions explicitly condition the event or behavior identified as being due to financial limitation (such as "... because we couldn't afford enough food" or "because there wasn't enough money to buy food. ") Each question addresses an explicit time frame, either the past 12 months or the past 30 days. Several key items include follow-up questions on how often the event or condition occurred within the past 12 months or the past 30 days.

Two separate measurement scales were developed, one for the severity of food insecurity within the 12-month period, the other for the 30-day period. The 12-month scale covers a broader range of severity levels of food insecurity and hunger, because fewer questions were asked in the 30-day time frame. The more comprehensive 12-month measure is expected to be the more useful, both for research and policy purposes, and is the focus of discussion in this report.

The scaling methodology began with exploratory linear and non-linear factor analyses to determine the number of distinct factors that should be represented. Scales were estimated using a Rasch measurement model, a form of non-linear factor analysis in the family of Item

Response Theory models.[1] Most food insecurity and hunger questions met the statistical criteria for inclusion in the models, although the resource augmentation questions did not. The fiil 12-month food security scale is based on answers to 18 questions, including some from each of the first four types of questions identified above.

Key findings during the scaling analysis were as follows:

- The results are consistent with previous research characterizing food insecurity as a "managed process" through several stages or levels of severity (Radimer et ***al.,*** 1992). In this process, households first note serious inadequacy in their food supply, feel anxiety about the sufficiency of their food to meet basic needs, and make adjustments to their food budget and food served. As the situation becomes more severe, adults experience reduced food intake and hunger, but they spare the children this experience. In the third stage, children also suffer reduced food intake and hunger and adults' reductions in food intake are more dramatic.

  The severity ranking of questions in the measurement scale proceeds generally in this order. At the same time, it shows that all three stages fit well in a single scale, which means that the level of severity of food insecurity can be measured as an essentially unidimensional aspect of the food insecurity/hunger phenomenon.

- The measurement models were tested with three different population groups: households with children; those without children but with one or more elderly members (age 60 or older); and those with neither children nor elderly members. Tests showed that a single scale can be used with all three populations.

- An extensive series of tests found the food security scale to have good reliability, including good internal (or content) validity and good external (or construct) validity.

Defining Levels of Severity of Food Insecurity and Hunger

Four categories of food security status are defined, based on the distinct behavioral stages associated with the managed process of food insecurity and hunger:

- ***Food secure*** — Households show no or minimal evidence of food insecurity.

[1] IRT models are a form of statistical measurement model developed in educational testing, where test items vary systematically in difficulty and the overall score measures the level of difficulty that the tested individual has mastered. In the present application, the severity of food insecurity that the household has experienced is analogous to the level of test difficulty that an individual has mastered.

- ***Food insecure without hunger*** — Food insecurity is evident in households' concerns and in adjustments to household food management, including reduced quality of diets. Little or no reduction in household members' food intake is reported.

- ***Food insecure with moderate hunger*** — Food intake for adults in the household has been reduced to an extent that it implies that adults have repeatedly experienced the physical sensation of hunger. Such reductions are not observed at this stage for children in the household.

- ***Food insecure with severe hunger*** — Households with children have reduced the children's food intake to an extent that it implies that the children have experienced the physical sensation of hunger. Adults in households with and without children have repeatedly experienced more extensive reductions in food intake at this stage.

Each household is classified into one of the four food security status categories on the basis of its value on the food security scale; Exhibit ES-l illustrates the process. Households with zero scale score are those reporting no indications at all of food insufficiency or insecurity. Households with low scale values are those reporting very slight experiences of food insecurity. Both these groups are classified as food secure. At the other extreme, households with high scale values are those who report experiencing all or nearly all of the conditions covered by the scale, and are classified as food insecure with severe hunger. A household classified into a particular category must normally have experienced all of the conditions associated with the less-severe categories, plus at least two or three of the conditions associated with the assigned category.

The Prevalence of Food Insecurity and Hunger in the United States

The large majority of American households were food secure in the year ending April 1995. About 88.1 percent of the approximately 100 million households in the United States are classified as food secure over that period, as illustrated in Exhibit ES-2. About 11.9 million households, however, experienced food insecurity at some level during that year.

Most of the food insecure households are classified as food insecure without hunger **(7.8** percent, or **7.8** million households). About **4.1** percent, however, are classified as food insecure with hunger. Thus, one or more adult members of some **4.2** million American households are estimated to have experienced reduced food intake and hunger as a result of financial constraints in the year ending in April 1995.

Exhibit ES-l

THE FOOD SECURITY STATUS CATEGORIES

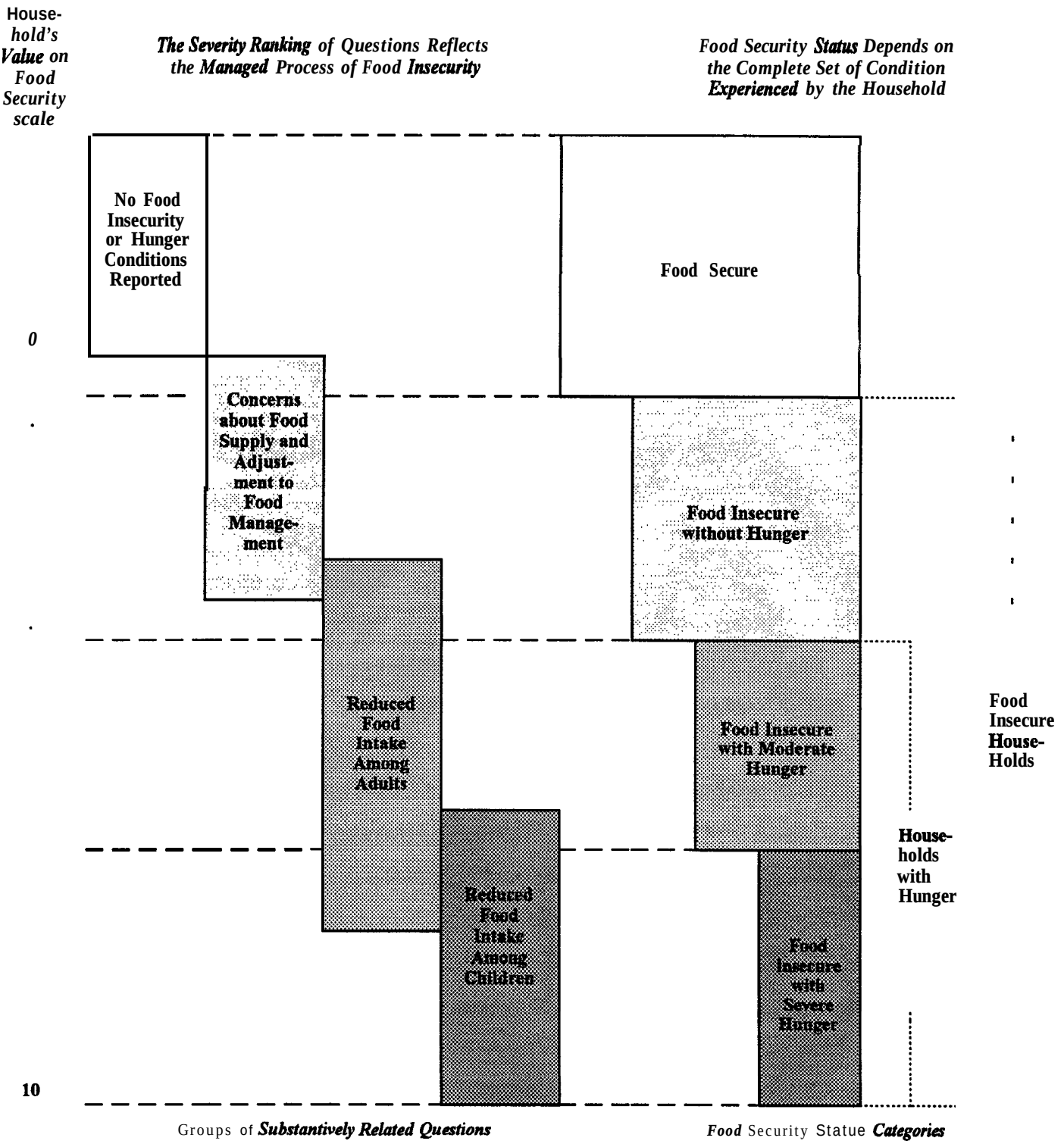
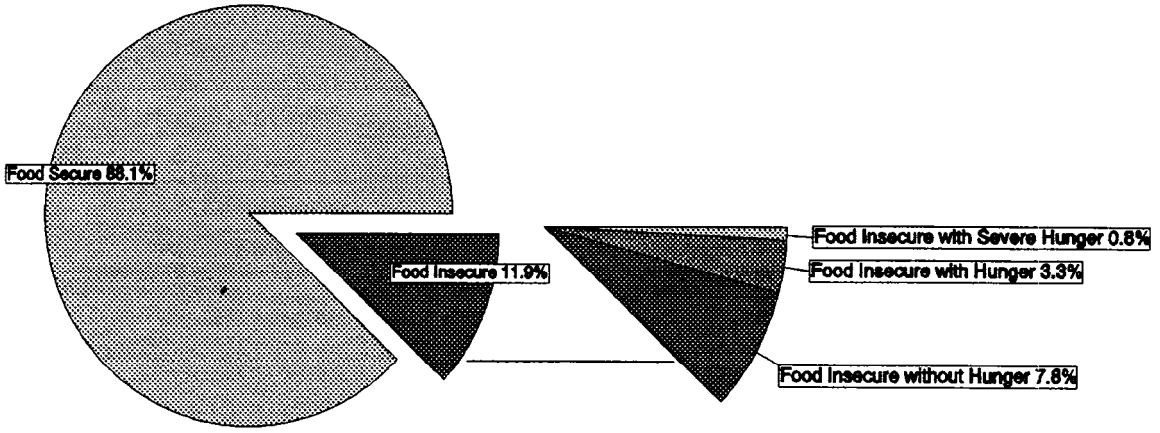


Exhibit ES-2

PREVALENCE OF FOOD SECURITY AND HUNGER, 1995



Among the households experiencing some level of hunger, about 800,000 (0.8 percent) are classified as food insecure with severe hunger. In these households, children as well as adults experienced reduced food intakes and hunger. Adults in these households had very substantial reductions in food intake, such as not eating for a whole day because of lack of money.

Food insecurity is clearly related to income and poverty, but the relationship is not exact. Not all poor households are food insecure, and only a small percentage of households with below-poverty incomes experience actual hunger (13.1 percent). The percent of households estimated to experience food insecurity is somewhat less than the poverty rate for individuals in the same period (12 percent vs. 15 percent). More than a third of poor households are classified as food insecure, whereas only 8 percent of households with above-poverty incomes are food insecure, and most of those have near-poverty incomes. Public and private food assistance programs may account for the fact that so many poor households are food secure, but this hypothesis has not yet been analyzed.

Even though food insecurity does not exactly follow income lines, food insecurity tends to be concentrated in population groups that have comparatively high poverty rates. For example, food insecurity rates are higher than average in female-headed households, in

households with children (especially young children), in Black and Hispanic households, and in central city areas.

Next Steps

The present analysis represents an important step in the measurement of food security, food insecurity, and hunger, but much more lies ahead for the food security measurement project. A task for the immediate future is to identify subsets of the questions in the CPS Food Security Supplement, and appropriate scaling procedures, so that smaller survey efforts can approximate the scale presented here with reasonable reliability. Another ongoing effort is to refine and strengthen the Food Security Supplement itself, so that the annual surveys planned for the future will yield comparable and increasingly reliable information. In the longer term, FCS and the larger research community will be undertaking several lines of data collection and analysis to understand better the phenomenon of food insecurity and to apply that understanding in the design and implementation of nutrition policies and food assistance programs.

Food Security Measurement Project Reports

Hamilton, W.L., J.T. Cook, W.W. Thompson, L.F. Buron, E.A. Frongillo, C.M. Olson, and C.A. Wehler. "Household Food Security in the United States in 1995: Summary Report of the Food Security Measurement Project." Cambridge, MA: Abt Associates Inc., 1995.

Hamilton, W.L., J.T. Cook, W.W. Thompson, L.F. Buron, E.A. Frongillo, C.M. Olson, and C.A. Wehler. "Household Food Security in the United States in 1995: Technical Report of the Food Security Measurement Project. " Cambridge, MA: Abt Associates Inc., 1995.

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Household Food Security in the United States in 1995

Technical Report

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Household Food Security in the United States in 1995 Technical Report 7

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Household Food Security in the United States in 1995

Technical Report of the Food Security Measurement Project

September 1997

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TABLE OF CONTENTS

Chapter One INTRODUCTION 1

Chapter Two METHODS AND RESULTS OF FITTING LINEAR AND NON-LINEAR FACTOR ANALYSIS MODELS TO CPS DATA .. 5

2.1 Preliminary Linear Factor Analysis 8
2.2 Exploratory Two-Parameter Non-linear Factor Analysis Model 10
2.3 Unidimensional One-Parameter Non-linear Factor Analysis Models 13
2.4 Summary 28

Chapter Three RELIABILITY ESTIMATES FOR THE FOOD SECURITY SCALES 29

3.1 Spearman-Brown Split-half Reliability Estimates 31
3.2 Rulon's Split-Half Reliability Estimates 33
3.3 Cronbach's Alpha Reliability Estimates 34
3.4 Rasch Model Reliability Estimates 35
3.5 Reliability in Identifying Cases with No Food Insecurity Problems 38
3.6 Summary 40

Chapter Four DEFINING RANGES OF THE FOOD SECURITY SCALE 43

4.1 Conceptual Basis for a Categorical Food Security Status Variable 43
4.2 Defining Ranges and Selecting Scale Cutpoints 45
4.3 Evidence of Food Insecurity 50
4.4 Subjective Reporting of Hunger 53
4.5 Evidence of Child Hunger and Severe Adult Hunger 56
4.6 Summary 58

Chapter Five THE RESOURCE AUGMENTATION QUESTIONS 61

5.1 Two Dimensions of Food Insecurity 61
5.2 The Composite Resource Augmentation Index 65
5.3 Effects of Using the Composite Resource Augmentation Index . 66
5.4 Summary 67

Chapter Six EXTERNAL CONSTRUCT VALIDATION OF THE FOOD SECURITY MEASURES 69

6.1 Relationship of Construct Validation Items to Food Security.. 69
6.2 Weekly Food Expenditures per Household Member 70
6.3 Household Income 72
6.4 Food Sufficiency 76
6.5 Summary 77

Chapter Seven PROCEDURES FOR CALCULATING STANDARD ERRORS FOR FOOD SECURITY PREVALENCE ESTIMATES 79

7.1 CPS Sample Design 79
7.2 Adjustment Factor for Between-PSU Variance 80
7.3 Estimation of Within-PSU Variance 81
7.4 Calculation of the Standard Errors 84

Chapter Eight POTENTIAL SOURCES OF BIAS IN PREVALENCE ESTIMATES 85

8.1 Screening Bias 86
8.2 Response Bias 88
8.3 Random Error in Survey Responses 89
8.4 Summary 92

REFERENCES 93

Appendix A REVIEW OF LITERATURE FROM PHYSIOLOGY AND CLINICAL NUTRITION RESEARCH ADDRESSING THE NATURE OF HUNGER

Appendix B PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS (30-DAY SCALE)

Appendix C PARTICIPANTS IN FEDERAL INTERAGENCY WORKING GROUP FOR FOOD SECURITY MEASUREMENT

CHAPTER ONE

INTRODUCTION

In April 1995, the U.S. Bureau of the Census conducted the first collection of comprehensive food security data as a supplement to its regular Current Population Survey (CPS). With about 45,000 household interviews, this survey is the first to collect the special data needed to measure food insecurity and hunger in a nationally-representative sample of U.S. households.

The Food and Consumer Service (FCS) of the U.S. Department of Agriculture led the effort to develop the Food Security Supplement to the CPS, building on research conducted at universities and elsewhere over the past decade. After the survey was conducted, the next step was to analyze the data to create measurement scales that gauge households' levels of severity of food insecurity and hunger. FCS contracted with Abt Associates Inc. and three subcontractors — the Tufts University Center on Hunger, Poverty, and Nutrition Policy; the Cornell University Division of Nutritional Sciences; and CAW and Associates — to carry out the scale construction analysis.

The results of that analysis are presented in ***Household Food Security in the United States in 1995: Summary Report of the Food Security Measurement Project,*** to which this report is a companion volume. The purpose of this report is to describe the analyses through which the food security scales and food security status variable were developed, as well as related tests of the reliability and validity of these measures.

Two scales were developed to measure the degree of food insecurity and hunger in American households. One measures food insecurity and hunger over the period of the 12 months prior to the survey interview, and the second measures these conditions in the 30 days immediately preceding the interview. After a number of exploratory analyses, a type of non-linear factor analysis known as a Rasch model was used to form the scales. This methodology and the procedures through which it was applied are described in Chapter Two.

The two scales were subjected to a variety of tests of reliability, including tests specific to the Rasch model and more traditional tests commonly used with scales developed through linear factor analysis. The results, presented in Chapter Three, generally indicate good

reliability for the 12-month scale. The 30-day scale, because it is based on a smaller number of questions and provides detailed measurement for a narrower portion of the food insecurity spectrum, has somewhat lower reliability.

The two scales serve as the basis for defining two corresponding food security status variables. The 12-month variable has four categories: (1) Food Secure; (2) Food Insecure with No Hunger Evident; (3) Food Insecure with Moderate Hunger Evident; and (4) Food Insecure with Severe Hunger Evident. The 30-day scale has three categories: (1) No Hunger Evident; (2) Food Insecure with Moderate Hunger Evident; and (3) Food Insecure with Severe Hunger Evident.

To classify households into the various categories, it was necessary to defme ranges on the 12-month and 30-day scales that correspond to each category. The rationale for the range definitions is described in Chapter Four.

The food security scale and the food security status indicator represent a central dimension of food insecurity: availability of enough food for the household to meet basic needs. The concept of food insecurity has other dimensions, however, including the specification that households should be able to acquire food in socially acceptable ways. Because the CPS Supplement includes several indicators of "coping" or "resource augmentation" behaviors related to this dimension of food insecurity, the possibility was explored of supplementing the primary food security scale with an index of resource augmentation actions. The analysis, described in Chapter Five, suggests that such an index should not be used in classifying households' food security status at this time.

A key question for any new scale is how accurately it represents the condition it attempts to measure. Ideally, one would compare the food security scales and status variables to some more definitive measure or measures of food insecurity and hunger. Because no such definitive measure exists, the best way to judge the measure is to assess its relationship to other measures thought to be related to food insecurity and hunger, such as the household's level of food expenditures or its total income. Chapter Six presents the results of such analyses, which show relationships of the sort that would be expected with a valid measure of food insecurity and hunger.

The central purpose of the food security scales and the status variables is to assess the food security of the U.S. population and of subgroups within the population. Estimates of the

prevalence of food insecurity and hunger are presented in the study's main report, based on the April 1995 data. Because these data come from a sample of households, prevalence estimates are subject to sampling error, and the report therefore presents estimated standard errors corresponding to the estimated prevalences. The estimation of standard errors is complicated by the multi-stage sampling design used by the CPS. Chapter Seven describes the methodology used in the estimation of standard errors.

Finally, Chapter Eight discusses the potential sources of bias in prevalence estimates that might result from the sample design of the CPS, from household response behaviors to the Food Security Supplement, and from the fact that only a small proportion of the population experiences food insecurity. The analysis indicates that the various potential sources of bias probably lead to quite small levels of estimation error in counterbalancing directions.

CHAPTER TWO
METHODS AND RESULTS OF SCALING ANALYSIS OF CPS DATA

This section describes the rationale and the results of conducting preliminary linear factor analyses and subsequently fitting a series of non-linear factor analysis models to the CPS food security data. This latter analysis approach more accurately characterizes the covariation among items in the CPS data set than more traditional linear factor analysis models. Most items available for analysis in the CPS data set were severely skewed and dichotomous or categorical in nature. Therefore, a number of statistical assumptions were violated using the linear factor analysis methods with the CPS items, such as the assumption of normally distributed error variance. Such situations can be dealt with more appropriately using non-linear scaling techniques.

Item Response Theory (IRT) describes a general model that was developed by the educational testing industry to assist in creating valid and reliable aptitude tests, such as the Scholastic Aptitude Test (SAT) and the American College Testing Program (ACT) test. When applying a particular IRT model to data, the test designer usually assumes that the responses to a set of items can be accounted for by latent traits or factors that are fewer in number than the test items. The primary goal is to determine how an individual with a certain ability level will respond to an item associated with a particular difficulty level. There are a number of alternative forms the IRT model can take, depending on the assumptions regarding how the underlying data were generated.

The three! most frequently discussed IRT models in the literature are (1) the three-parameter logistic model, (2) the two-parameter logistic model, and (3) the one-parameter logistic model, The three-parameter logistic IRT model is the most complex, and can include varying discrimination parameters, varying difficulty levels, and varying guessing parameters. Using the notation of Hambleton (1983),[1] the three-parameter logistic model can be written as follows:

[1] Hambleton, R.K. (ed.), ***Application of Item Response Theory,*** Vancouver: Educational Research Institute of British Columbia, 1983.

$$P_{ni}(\theta_n) = c_i + (1 - c_i) \frac{e^{Da_i(\theta_n - b_i)}}{1 + e^{Da_i(\theta_n - b_i)}} \quad (1)$$

where

θ_n = latent trait score of person n,

a_i = item discrimination parameter for item I

b_i = item difficulty for item I,

c_i = guessing parameter for item I,

n = person, and

I = item.

The two-parameter logistic model assumes that guessing does not occur, and therefore the guessing term is dropped from the model. The two-parameter logistic model can be expressed as follows:

$$P_{ni}(\theta_n) = \frac{e^{Da_i(\theta_n - b_i)}}{1 + e^{Da_i(\theta_n - b_i)}} \quad (2)$$

where

θ_n = latent trait score of person n,

a_i = item discrimination parameter for item I,

bi = item difficulty for item I,

n = person, and

I = item.

Finally, the one-parameter logistic model is a more straightforward model relative to the two previous models, because the model (1) has no guessing parameters, and (2) specifies that all items have the same discrimination parameter ($\tilde{a}$). That is, the slopes of the item-characteristic curves are constrained to be equal for all items. The model can be written as follows:

$$P_{ni}(\theta_n) = \frac{e^{D\bar{a}(\theta_n - b_i)}}{1 + e^{D\bar{a}(\theta_n - b_i)}} \quad (3)$$

where

θ_n = latent trait score of person ***n,***

$\bar{a}$ = average item discrimination parameter for item ***I,***

b_i = item difficulty for item I,

n = person, and

I = item.

Because ***D*** and $\bar{a}$ are constants in the model, the one-parameter logistic model can be written in a more simplified form:

$$P_{ni}(\theta_n) = \frac{e^{(\theta_n^* - b_i^*)}}{1 + e^{(\theta_n^* - b_i^*)}} \quad (3)$$

We can also express this model using the notation of Wright and Masters (1982):

$$P_{nik}(\theta) = \frac{e^{[\beta_n - (\delta_i + \tau_k)]}}{1 + e^{[\beta_n - (\delta_i + \tau_k)]}} \quad (4)$$

where

β_n = latent trait score of person ***n,***

δ_i = item difficulty for item I,

τ_k = threshold parameter for step k of item I,

n = person,

I = item, and

k = step,

and include a threshold parameter that is associated with the rating scale model developed by **Andrich** (1978, 1979).

2.1 PRELIMINARY LINEAR FACTOR ANALYSIS

The CPS Food Security Supplement builds on a substantial amount of recent research on the measurement of food insecurity, some of which included scaling analysis.[2] The first analytic step was to replicate some of the prior analyses to determine whether the general patterns and relationships in the data were similar to those seen in prior work.

A series of linear factor analyses were fit to the CPS data. One illustrative model, summarized in Exhibit 2-1, was fit for households with children (because this group was asked all questions in the Supplement). The factor model incorporated a Procrustes rotation, which allows one to rotate to a pre-specified factor solution, where the solution was specified to represent the dominant themes of the prior research. Fitting the factor analysis model resulted in three factors with eigenvalues greater than 1.0 prior to rotation (15.0, 1.6, and 1.4), with factor loadings as shown in the exhibit. The first factor includes primarily items related to child food intake reductions and hunger, the second consists mainly of household-level food insecurity items, and the third comprises mainly items related to adult food intake reduction and hunger.

In sum, the results generally confiied that the response patterns in the CPS data were similar to those seen in prior research and that similar relationships might be expected to exist. In addition, the large positive factor intercorrelations suggested the possibility that non-linear factor analysis methods might result in the items loading onto a single factor (i.e., that the separation of factors could occur in part because of the limitations of linear factor analysis in handling low-frequency dichotomous items). Finally, exploratory analyses of groups of households without children suggested that, for those items applicable to all groups, the factors might be relatively invariant across groups.

[2] Two key prior studies are Olson, Frongillo, and Kendall (1995), and Scott, Wehler, and Anderson (1995). The first study estimated a factor analysis model including four items from the Community Childhood Hunger Identification Project (CCHIP) and ten items from two previous Cornell surveys. The analysis identified two key factors, one associated with household-level food insecurity and one associated with hunger. The second study, analyzing data from multiple CCHIP studies, found a first factor comprising mainly household-level food insecurity items and adult hunger items, whereas the second factor included mainly child hunger items.

Exhibit 2-1

SUMMARY OF FACTOR LOADINGS FOR LINEAR FACTOR ANALYSIS MODEL (n=2,991)

Items	Standardized Regression Coefficients		
	F_1	F_2	F_3
Q11		38	
Q15		59	
Q16		63	
Q20		52	
Q24			45
Q28			52
Q32			47
Q35			48
Q38			43
Q40	50		
Q43	42		
Q47	60		
Q50	40		
Q53		78	
Q54		76	
Q55		78	
Q56		73	
Q57	49		
Q58		75	

2.2 EXPLORATORY TWO-PARAMETER NON-LINEAR FACTOR ANALYSIS MODEL

Initially, we fit a series of exploratory non-linear factor analysis models to determine **the dimensionality of the** Food Security Survey items.[3] From these alternative models, we selected one representative non-linear model, labeled M121, which best describes the consistent findings across the various alternative models. Ml21 was fit as a two-parameter logistic model that included estimates for both factor loadings (discrimination parameters) and uniquenesses (error term).[4] Descriptive statistics for the subsample of 994 subjects and 21 items are presented in Exhibit 2-2. The items ranged in proportion of positive responses from .850 (item 15) to .004 (item 50), where the higher the proportion, the lower the severity of food insecurity indicated by the particular item.

The results of the non-linear factor analysis model are presented in Exhibit 2-3. The primary fit statistic, the root mean square residual (RMSR) suggested that the one-factor model adequately fit the data (RMSR = .0074). That is, the RMSR was well within the acceptable range with a single factor, and was not materially improved by adding further factors, making the single-factor model the most parsimonious solution. As with the linear factor analysis model, items 15 and 23 were poor-fitting, with low factor loadings (. 3 1 and .22, respectively). Item 22 had a moderately positive factor loading (L = .43), whereas the rest of the items all had large positive loadings above .50. The findings support the linear factor analysis results with respect to item fits, but suggest that items 15 and 23 should be removed from subsequent models.

[3] Exploratory non-linear factor analysis models were fit using two software packages: LISCOMP and NOHARM. LISCOMP is a structural equation modeling program that is designed to work with dichotomous and/or ordinal data. NOHARM is a non-linear factor analysis program that analyzes moment matrices. Both programs allow one to fit a two-parameter item response theory model (non-linear factor analysis model) to the data. Exploratory analysis focused on households with children in random 25 percent subsamples of the Food Security Supplement sample. Households that did not pass the series of screening questions (i.e., higher-income households with no indication of food insecurity), and consequently were not asked the full series of food insecurity and hunger questions, were excluded from the analysis.

[4] The two-parameter model can be fit with either item difficulty or uniqueness as the second parameter. The specification shown here chose the uniqueness parameter.

Exhibit 2-2

DESCRIPTIVE STATISTICS FOR MODEL Ml21

Variable	Mean	Std	Sum
Q11	.231	.421	231
Q15	.850	.356	850
Q16	.450	.497	450
Q18	.325	.468	325
Q19	.095	.293	95
020	.274	.446	274
021	.585	.492	585
Q22	.122	.327	122
Q23	.016	.125	16
Q24	.244	.429	244
Q28	.054	.226	54
Q32	.233	.423	233
Q35	.123	.328	123
Q38	.047	.211	47
Q40	.048	.213	48
Q43	.023	.150	23
Q47	.049	.216	49
Q50	.004	.063	4
Q53	.600	.490	600
Q54	.434	.495	434
Q55	.398	.489	398
Q56	.267	.442	267
Q57	.137	.344	137
Q58	.377	.484	377

Exhibit 2-3

SUMMARY OF FACTOR LOADINGS FOR MODEL Ml21

Item	Item Label	Standardized Regression Coefficients
		F_1
Q11	General food sufficiency question	70
Q15	Try to make food or money go further	*31*
Q16	Run out of foods needed to make meal	70
Q18	Borrow food or money to make meal	56
Q19	Take child to other home for meal	68
Q20	Serve few low-cost foods several days in a row	73
Q21	Put off paying bills to buy food	51
Q22	Get emergency food from church or food bank	*43*
Q23	Eat meal at soup kitchen	22
Q24	Adults cut or skip meals because not enough money for food	89
Q28	Adults don't eat for whole day	79
Q32	Eat less than should because not enough money to buy food	88
Q35	Hungry but don't eat because can't afford to	85
Q38	Lost weight because not enough food	75
Q40	Child's meal size cut because not enough money for food	76
Q43	Child skip meal because not enough money for food	60
Q47	Child hungry but can't afford more food	80
Q50	Child did not eat for a whole day	71
Q53	Worry food will run out before getting money for more	79
Q54	Food doesn't last and don't have money to get more	89
Q55	Can't afford to eat balanced meals	88
Q56	Can't feed children a balanced meal	85
Q57	Child not eating enough because can't afford more food	83
Q58	Child fed only few low-cost foods, running out of money	82

2.3 UNIDIMENSIONAL ONE-PARAMETER NON-LINEAR FACTOR ANALYSIS MODELS

The exploratory non-linear factor analysis models indicated that the Food Security Survey items could be described efficiently as a unidimensional construct. Therefore, we pursued a specific non-linear factor model called the Rasch model. The Rasch model is a concise one-factor model that constrains the discrimination parameters (factor loadings) to be equal across all items. The statistical constraints of the Rasch model result in several desirable properties for the measurement scale, especially its robustness across multiple samples and multiple variations of the test (Wright and Masters, 1982). Furthermore, the preliminary exploratory models indicated that most of the items had very similar discrimination parameters when the discrimination parameters were allowed to vary.[5]

The computer program BIGSTEPS was designed specifically to fit the unidimensional Rasch model. All subsequent models described in this section were fit using BIGSTEPS.

Five alternative measurement models based on existing theoretical frameworks were generated for the Food Security Survey items. The five alternative models are summarized in Exhibit 2-4. For most of the models, the items were divided into two subsets based on the specific time frame that the items referenced. For models R101, R102, and R103, the first subset of items references behaviors and events that occurred in the last 12 months, whereas the second subset references behaviors and events that occurred in the last 30 days. Models were fit separately for the 12-month and 30-day time periods.

A general summary of item fits for the alternative models is presented in Exhibit 2-5. The identification of poorly-fitting items and/or redundant items is based on item in-fit and out-fit statistics. The out-fit statistic, μ_i, is an unweighted fit statistic. It is based on a standardized residual, written as:

$$z_{ni} = \frac{y_{ni}}{W_{ni}^{.5}}$$

where y_{ni} is the score residual for household n on item i, and W_{ni} is the variance of the score

[5] Note in Exhibit 2-3 that nearly all factor loadings fall in the fairly narrow range from 70 to 88. The questions with loadings substantially outside this range (Q15, Q18, Q21, Q22, Q23) are all ultimately excluded from the scale.

Exhibit 2-4

ALTERNATIVE NON-LINEAR FACTOR ANALYSIS MODELS

Model	12-Month Scale	30-Day Scale
R101	Scale includes items that referenced events that occurred in the last 12 months. Items 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 28, 29, 32, 35, 38, 40, 43, 44, 47, 50, **53b, 54b, 55b, 56b, 57b,** 58b.	Scale includes items that referenced events that occurred in the last 30 days. Items 17, 26, 27, 30, 31, 33, 34, 36, 37, 39, 41, 42, 45, 46, 48, 49, 5 1, 52.
R102	Scale includes items that referenced events that occurred in the last 12 months, and excludes resource augmenting behaviors (18, 19, 21, 22, and 23). Items 15, 16, 20, 24, **25, 28, 29, 32, 35, 38,** 40, 43, 44, 47, 50, **53b, 54b, 55b, 56b, 57b,** 58b.	Scale includes items that referenced events that occurred in the last 30 days, and excludes resource augmenting behaviors. Items 17, 26, 27, 30, 31, 33, 34, 36, 37, 39, 41, 42, 45, 46, 48, 49, 51, 52.
R103	Scale includes food insecurity items based on the CCHIP model. Items 15, 18, 19, 20, 21, 22, 23, **53a, 55a, 56a,** 58a.	Scale includes food insufficiency and hunger items based on the CCHIP model. Items 16, 17, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, **54a,** 57a.
R104	N A	Scale includes items that reference events that occurred in the last 30 days. When no **30-day** reference was available, items that referenced the last **12-month** period are included. Items 15, 17, 18, 19, 20, 21, 22, 23, 26, 27, 30, 31, 33, 34, 36, 37, 39, 41, 42, 45, 46, 48, 49, 51, 52, **53a, 54a, 55a, 56a, 57a,** 58a.
R105	NA	Scale includes items that referenced 30-day period and number of days in the last month. Also includes items that reference "often true" in the last 12 months. Items 17, 26, 27, 30, 31, 33, 34, 36, 37, 39, 41, 42, 45, 46, 48, 49, 51, 52, **53a, 54a, 55a, 56a, 57a,** 58a.

NOTES:

(1) For items that referenced number of days, one dummy code was created based on whether the behavior or experience occurred **five** or more times in the last month.

(2) For items that referenced number of months, one dummy code was created by combining the two more extreme categories of the variable, indicating the experience occurred in three or more of the past 12 months.

(3) For items **Q53** through **Q58,** 'a' denotes a **dummy code that represents 'often true,' whereas 'b' denotes** a dummy code that combines 'sometimes true' and 'often true.'

Exhibit 2-5

SUMMARY OF RESULTS FROM ALTERNATIVE NON-LINEAR FACTOR ANALYSIS MODELS

Model	12-Month Scale		30-Day Scale	
	Poorly Fitting Items	Redundant Items	Poorly Fitting Items	Redundant Items
R101	Q21, Q18, Q15, Q22	Q54b	Q17	No redundant items
R102	Q15, Q16, Q20	No redundant items	Q17	No redundant items
R103	No poor fitting items.	No redundant items	Q16, Q17, Q43	Q26
R104	NA	NA	Q22, Q23	Q33
R105	NA	NA	Q58a, Q17	No redundant items

residual. The standardized residual is then squared and averaged to obtain a mean estimate of item fit.

$$\mu_i = \frac{\Sigma z_{ni}^2}{N}$$

The in-fit statistic, v_i, is a weighted fit statistic that includes the same squared standardized residual as μ_i, and is written as:

$$v_i = \frac{\Sigma W_{ni} z_{ni}^2}{W_{ni}}$$

Both the in-fit and out-fit statistics have an expected value of 1 .O. As they deviate from 1.0, the associated items become candidates for removal from the scale. Generally speaking, a mean square fit statistic that is greater than 1.20 indicates a poor fitting item, whereas a mean square fit statistic that is less than .80 indicates an item is redundant with other similar types of items in the scale. ***Items that have both an in-fit and out-fit statistic above 1.2 are targeted for removal from the scale.*** Items with both in-fit and out-fit statistics below .80 are redundant with respect to the information they share with other items in the scale. Items that were shown to be redundant items were also considered for removal and/or combined with other items. Below we focus on describing the results of the 12-month and 30-day scale for M102, because

these two specific models were subsequently considered the most parsimonious by the study team.

12-Month Food Security Scale

As with the linear factor analysis models, all Rasch models were initially tested using only households with children, because they comprised the subsample of households that were administered the entire set of food security items. The results for Model M102 are presented in Exhibit 2-6. The summary table contains a large amount of information, briefly described below.

The order of items in the table is determined by their item ***calibration,*** shown in the fourth column of Exhibit 2-6. A question's item calibration represents the point on the scale at which there is a 50 percent probability that any given household will respond "yes" to the item. That is, households with higher values on the scale than a particular item's calibration score have a greater than 50 percent probability of answering that item positively; households with lower values have a less than 50 percent probability of a positive response to the item in question. The items are listed from high calibration at the top of the table to low calibration at the bottom.

The item calibration is a function of (1) the total number of individuals that have responded to any item in the scale (1,687); (2) the number of individuals that responded to the particular item in the scale (n); and (3) the number of positive responses to the particular item (raw score). For example, item 50 refers to the item "child did not eat for a whole day. " The item has an item calibration of 4.56, which is the highest in the table. This event occurs rarely in any household. For this specific subsample, this event occurred for only 12 of the 1,684 households that responded to the item. At the other end of the scale, item 15 ("run short of money and try to make food or food money go further") is the least severe item included in the analysis. The item has the low calibration of -5.74, based on 1,469 positive responses out of the 1,686 households that answered the question.

The column headed "Real SE" shows the standard error of the items, which can be used to create a confidence interval for the item calibration. Items located at the severe end of the scale tend to have the largest standard errors, because they tend to have larger variances compared to items throughout the center and less-severe end of the distribution.

Exhibit 2-6

SUMMARY OF MODEL **R102A**

Item	*n*	Raw Score	Item Calibration	Real SE	In-fit		Out-fit		Point Biserial Corr.
					Mean Sq	Z	Mean Sq	Z	
Q50	1,684	12	4.81	.30	.99	0.0	.28	-0.4	.19
Q44	1,684	23	4.01	.22	1.00	0.0	.41	-0.5	.24
Q43	1,684	38	3.36	.18	1.04	0.3	1.73	0.5	.28
Q29	1,683	62	2.68	.14	.89	-1.1	.28	-1.3	.39
Q40	1,683	86	2.21	.13	1.01	0.1	1.99	1.2	.40
Q47	1,684	89	2.15	.12	.88	-1.5	.56	-0.8	.44
Q38	1,683	91	2.12	.13	1.07	0.8	.46	-1.1	.40
Q28	1,684	95	2.06	.12	.95	-0.6	.41	-1.3	.44
Q35	1,685	212	.65	.09	.91	-1.6	.83	-0.6	.57
Q57	1,680	246	.36	.09	1.00	0.1	.60	-1.8	.57
Q25	1,683	293	-.01	.08	.94	-1.3	.56	-2.4	.61
Q32	1,683	442	-.98	.07	.94	-1.5	.67	-2.7	.64
Q24	1,685	449	-1.01	.07	.86	-3.5	.67	-2.8	.67
Q56	1,679	466	-1.12	.07	1.04	0.9	.75	-2.1	.61
Q20	1,686	480	-1.19	.08	1.24	5.5	1.50	3.5	.52
Q58	1,680	671	-2.18	.07	.99	-0.4	.96	-0.4	.60
Q55	1,678	706	-2.36	.07	.87	-3.6	.68	-3.5	.64
Q54	1,679	785	-2.73	.06	.82	-5.2	.74	-2.5	.64
Q16	1,687	795	-2.77	.07	1.23	5.9	1.22	1.9	.50
Q53	1,680	1,066	-4.01	.06	.95	-1.6	.85	-0.8	.49
Q15	1,686	1,469	-6.06	.09	1.31	6.7	7.70	5.5	.10
Mean	1,683	408	.00	.11	1.00	-0.1	1.14	-0.6	
SD	2	382	2.82	.06	.13	2.9	1.53	2.1	

NOTE:

Sample includes households with children only. Items are ordered on terms of severity.

For the 12-month scale presented in Exhibit 2-6, there are three items with both in-fit and out-fit statistics that exceed 1.20 (Q15, Q16, and 420). Therefore, these three items were removed from the scale, and the model re-estimated. The results of the revised model are presented in Exhibit 2-7. The effective sample size for the revised model is reduced (n = 1,276) because two of the least severe items were removed from the analysis. This results in fewer subjects who have responded yes to any particular item.

For the revised model, there are no items with both in-fit and out-fit statistics that exceed 1.20. Similarly, there are no items with both in-fit and out-fit statistics below .80. Some of the out-fit statistics were small, due primarily to dependencies in some item pairs. For example, item 29 has a low out-fit statistic (mean square = .36), but the item is associated with item 28. We examined several alternative models with these items modeled as trichotomies rather than the multiple dichotomies, but the basic results of the models did not change.

Final 12-Month Food Security Scale

The analyses for the 12-month scale were replicated on subsequent subsamples of the data set.[6] The model replications provided clear support for the invariance of the primary measurement model across subsamples, as well as across different types of households. In each replication, the item calibrations gave identical or near-identical rankings of item severity and consistent clustering of closely-ranked items. Applying models fit on separate subsamples yielded household values that correlated at the .99 level.[7]

The final model estimates are based upon all households in the analysis sample; these are presented in Exhibit 2-8. Of the 18,370 households that passed the screener and responded to at least half of the questions applicable to them, there were 7,897 households in which the respondent answered "yes" to at least one of the 12-month scale items. The ordering of the

[6] The overall sample was initially divided into four random subsamples. Initial model estimation was carried out for households with children within one subsample. Tests for invariance were performed for households with children in the other three random subsamples. Invariance tests were also performed for households without children, subdividing them into households with any elderly members (age 60 or over) and households with no elderly members.

[7] In this procedure, we separately fit the model to each subpopulation, such as households with children, households with no children but with elderly members, and households with neither children nor elderly. Each of the separate models was then used to compute scale values for all households in the full sample. The values computed with the different models were then compared through plotting and correlation. analysis.

Exhibit 2-7

SUMMARY OF REVISED MODEL **R102A**

Item	*n*	Raw Score	Item Calibration	Real SE	In-fit		Out-fit		Point Biserial Corr.
					Mean Sq	Z	Mean Sq	Z	
Q50	1,275	12	4.38	.30	.96	-0.2	.32	-0.5	.21
Q44	1,275	23	3.59	.22	.99	-0.1	.50	-0.5	.25
Q43	1,275	38	2.93	.18	1.01	0.1	1.50	0.5	.29
Q29	1,274	62	2.26	.14	.90	-1.0	.36	-1.4	.40
Q40	1,274	86	1.77	.13	1.02	0.2	2.34	2.0	.39
Q47	1,275	89	1.72	.12	.88	-1.4	.70	-0.7	.45
Q38	1,274	91	1.69	.13	1.09	1.1	.65	-0.8	.39
Q28	1,275	95	1.63	.12	.96	-0.5	.52	-1.3	.44
Q35	1,276	212	.21	.09	.95	-0.9	1.09	0.4	.55
Q57	1,274	246	-.11	.09	.99	-0.2	.65	-2.1	.56
Q25	1,274	293	-.49	.08	.98	-0.4	.76	-1.6	.57
Q32	1,274	442	-1.53	.08	1.01	0.2	.99	-0.1	.57
Q24	1,276	449	-1.56	.08	.96	-1.0	1.01	0.1	.59
Q56	1,273	466	-1.68	.08	1.08	1.9	.97	-0.3	.54
Q58	1,274	671	-2.89	.08	1.11	2.6	1.28	2.1	.47
Q55	1,272	706	-3.09	.07	.94	-1.7	.84	-1.2	.53
Q54	1,273	785	-3.54	.07	.92	-2.2	.94	-0.4	.49
Q53	1,274	1,066	-5.28	.09	1.16	3.7	1.28	0.7	.23
Mean	1,274	324	.00	.12	.99	0.0	.93	-0.3	
SD	1	303	2.70	.06	.07	1.5	.46	1.1	

NOTE:

Sample includes households with children only. Items are ordered in terms of severity.

items in the final model changes slightly relative to the ordering of the items described in Exhibit 2-7; however, these minor fluctuations in item severities are expected with different random subsamples of households. [8]

Exhibit 2-9 shows the frequency distribution for the number of responses to items in the survey. The two most frequent response patterns are 10 items and 18 items.[9] The response pattern of 10 items applies largely to the households without children, because these had the opportunity to respond to a maximum of 10 items. The response pattern of 18 items applies to households with children, who had an opportunity to respond to 18 items. These two response patterns account for 98.8 percent of the households, indicating a very low incidence of item nonresponse (1.2 percent of all respondents). Households, whether with or without children, that responded to less than half the items administered had their household score set to "missing."

The central function of the Rasch model is to assign to each responding household a value on the food security scale. The household scale value is fundamentally based on a count of the number of affirmative responses to questions included in the scale. At its simplest, if all households respond to the same set of questions, the household scale value is a constant arithmetic transformation of the count of positive responses. For example, among households with children responding to all 18 questions in the scale, all households with three positive responses have a scale value of -4.13. Households with more affirmative responses have higher scale values; for example, households with children giving ten affirmative responses have a scale value of 0.62. The scale value does not depend on which questions the household answers affirmatively: all households with children who give three affiative answers have the same scale value, even if they give affirmative answers to quite different questions.

[8] The Rasch model software initially assigns scale values in a range that yields a mean of zero. Because the presence of positive and negative values in the scale can be confusing or misleading, it is conventional to transform the values into a range such as O-l, O-10, or O-100. Values of the 12-month scale presented in other reports from this project transform the original scale values to range from 0.0 to 10.0. The original value is multiplied by .8333 and added to 5.071 to obtain the transformed value. All respondents giving zero affirmative responses are assigned a value of zero, and respondents answering all questions affirmatively get a value of 10.0.

[9] Over half of all households in the sample were higher-income households that did not pass the screening questions, and therefore were not asked any of the questions included in the scales.

Exhibit 2-8

SUMMARY OF FINAL 12-MONTH SCALE

Item	*n*	Raw *Score*	Item Calibration	Real SE	In-fit Mean Sq	In-fit Z	out-fit Mean Sq	out-fit Z	Point Biserial Corr.	Transformed Item Calibration[a]
Q50	*4,333*	*29*	*4.92*	.20	1.09	0.5	*6.02*	1.8	.18	9.2
Q44	*4,331*	*87*	*3.48*	.12	.84	*-1.8*	.28	*-1.6*	.34	*8.0*
Q43	4,332	135	2.86	.10	.88	-1.7	.78	-0.5	.37	7.5
Q29	7,889	332	2.55	.06	.89	-2.5	.55	-1.8	.35	7.2
Q47	4,333	257	1.88	.07	.93	-1.3	.97	-0.1	.44	6.6
Q28	7,892	537	1.82	.05	.97	-1.0	1.16	0.8	.39	6.6
Q40	4,333	290	1.69	.07	1.01	0.3	1.28	1.0	.44	6.5
Q38	7,861	625	1.54	.05	1.10	3.1	1.31	1.6	.39	6.4
Q35	7,883	1,249	.27	.04	.91	-4.0	.77	-2.6	.54	5.3
Q57	4,324	779	-.15	.05	1.07	2.3	.86	-1.4	.53	5.0
Q25	7,879	1,919	-.70	.03	.93	-3.4	.76	-4.6	.58	4.5
Q32	7,885	2,661	-1.56	.03	.94	-3.5	.94	-1.5	.57	3.8
Q56	4,325	1,453	-1.64	.04	1.08	3.4	.94	-1.0	.54	3.7
Q24	7,893	2,824	-1.72	.03	.88	-7.3	.87	-3.2	.59	3.6
Q58	4,324	2,295	-3.10	.04	1.14	6.5	1.29	3.3	.43	2.5
Q55	7,862	4,627	-3.42	.03	1.03	2.1	1.61	7.9	.41	2.2
Q54	7,863	4,973	-3.73	.03	.92	-5.9	1.06	0.8	.42	2.0
Q53	7,870	6,312	-4.99	.03	1.16	9.9	3.04	9.4	.18	0.9
Mean	6,301	1,744	.00	.06	.99	-0.2	1.36	0.5		
SD	1,763	1,833	2.71	.04	.10	4.2	1.26	3.5		

[a] The transformed item calibration is a linear transform of the item calibration that places all values in the range from 0.0 to 10.0.

If all respondents are given exactly the same set of questions, the scale value depends solely on the number of affirmative responses. If different respondents answer different sets of questions, however, scale values depend on the severity (as indicated by the item calibration) of the questions that the respondent answers. In the current situation, households with children are asked 18 questions, whereas those without children are asked only ten. Moreover, the

Exhibit 2-9

NUMBER OF QUESTIONS ANSWERED: QUESTIONS IN THE 12-MONTH SCALE

Number of Questions Answered	Frequency	Percent	Cumulative Frequency	Cumulative Percent
2	7	0.0	7	0.0
3	4	0.0	11	0.1
4	6	0.0	17	0.1
5	11	0.1	28	0.2
6	14	0.1	42	0.2
7	53	0.3	95	0.5
8	11	0.1	106	0.6
9	51	0.3	157	0.9
10	10293	55.9	10450	56.8
12	21	0.1	10471	56.9
13	2	0.0	10473	56.9
14	2	0.0	10475	56.9
15	3	0.0	10478	56.9
16	11	0.1	10489	57.0
17	29	0.2	10518	57.1
18	7888	42.9	18406[a]	100.0

[a] Households that answered fewer than half of the applicable questions are excluded from the main analysis, reducing the sample to 18,370.

questions asked only of households with children are disproportionately the more severe questions. The Rasch model takes these differences into account, assigning values to both types of household that are comparable even though they responded to different types of questions. Similarly, the model adjusts the scale values assigned to households with or without children that failed to respond to one or more of the items applicable to them.

The frequency distribution of household values on the 12-month scale is presented in Exhibit 2-10. Household values for the 12-month scale range from -6.08 to 5.91 in the original model estimation (values transformed to a O-10 range are also shown). Most households in the analysis sample responded "no" to all items in the scale, and received a scale value of – 6.08

Exhibit 2-10

FREQUENCY DISTRIBUTION FOR HOUSEHOLD VALUES
ON THE **12-MONTH** SCALE

Value on Scale	Frequency	Percent	Cumulative Frequency	Cumulative Percent	Transformed Scale Value[a]
-6.08	10276	56.5	10276	56.5	0.0
-5.2	970	5.3	11246	61.9	0.7
-4.96	902	5.0	12148	66.8	0.9
-4.13	661	3.6	12809	70.5	1.6
-3.73	614	3.4	13423	73.8	2.0
-3.36	550	3.0	13973	76.9	2.3
-2.73	657	3.6	14630	80.5	2.8
-2.69	386	2.1	15016	82.6	2.8
-2.09	343	1.9	15359	84.5	3.3
-1.82	306	1.7	15665	86.2	3.6
-1.52	358	2.0	16023	88.1	3.8
-0.97	255	1.4	16278	89.5	4.3
-0.96	285	1.6	16563	91.1	4.3
-0.43	188	1.0	16751	92.1	4.7
-0.09	295	1.6	17046	93.8	5.0
0.1	176	1.0	17222	94.7	5.2
0.62	132	0.7	17354	95.5	5.6
0.81	231	1.3	17585	96.7	5.8
1.13	86	0.5	17671	97.2	6.0
1.62	59	0.3	17730	97.5	6.4
1.75	128	0.7	17858	98.2	6.5
2.12	59	0.3	17917	98.6	6.8
2.65	28	0.2	17945	98.7	7.3
2.88	85	0.5	18030	99.2	7.5
3.24	15	0.1	18045	99.3	7.8
3.77	103	0.6	18148	99.8	8.2
3.96	12	0.1	18160	99.9	8.4
5.02	13	0.1	18173	100.0	9.3
5.91	6	0.0	18179[b]	100.0	10.0

[a] The transformed scale value is a linear transform that places all values in the range from 0.0 to 10.0.

[b] Includes only households that responded to all applicable items.

(10,276 households). [10] All other households responded "yes" to at least one item. Their assigned scale value is a non-linear transformation of the total number of items to which they responded affirmatively. If all households had responded to all 18 items, there would be 19 possible scale score values that could be assigned to households. Because households without children could respond to only 10 items, however, there are a number of additional scale scores that can be assigned to households based on a missing data adjustment that is part of the Rasch measurement model. The small proportion of households in either group that failed to respond to one or more questions also received distinct measure scores, depending on the number of items missed.

Final 30-Day Food Security Scale

The 30-day scale was developed in the same manner as the 12-month scale, though there were fewer 30-day items available for analysis. The 30-day scale also has a larger number of item dependencies than the 12-month scale. The results of the final Rasch model for the 30-day scale are presented in Exhibit 2-l 1. The 30-day scale includes 17 items, and the estimated item calibrations range from -4.37 to 4.00. For the most severe item (item 52), only five households responded affirmatively .

Exhibit 2-12 shows the number of responses households made to the 30-day items administered in the survey. Similar to the 12-month scale, there were two major response categories: 9 (households without children) and 17 (households with children). These two response patterns account for 99.3 percent of households. Here also, households that did not respond to at least half the items administered had their scale value set to "missing."

Exhibit 2-13 provides the frequency distribution of the 30-day household scale scores. The scale scores range from -5.62 to 5.32. Almost 90 percent of the households that passed the series of screening questions responded "no" to all items in the 30-day scale.

The 30-day scale in its present form is not considered as useful as the 12-month scale, for both conceptual and statistical reasons. Conceptually, the 30-day scale provides detail on a narrower portion of the spectrum of food insecurity than the 12-month scale. Most of the less-

[10] For analyses involving the full sample, households that did not pass the screen are assigned the minimum possible score (-6.08). This procedure is also used in classifying households on the food security status variables.

Exhibit 2-11

SUMMARY OF FINAL 30-DAY SCALE

Item	*n*	Raw Score	Item Calibration	Real SE	In-fit		Out-fit		Point Biserial Corr.
					Mean Sq	Z	Mean Sq	Z	
Q52	990	5	4.00	.45	.83	-0.4	.22	-0.7	.23
Q51	990	13	2.91	.30	1.07	0.3	1.04	0.0	.20
Q46	988	21	2.33	.23	.92	-.4	.68	-0.5	.34
Q31	1992	83	1.61	.12	.83	-1.9	.27	-3.2	.34
Q49	990	45	1.37	.16	.80	-1.7	.44	-1.7	.47
Q42	990	64	.91	.14	.88	-1.1	.59	-1.5	.46
Q45	988	69	.80	.14	1.10	1.0	1.67	1.8	.32
Q37	1985	249	.10	.08	.84	-3.3	.51	-4.1	.46
Q48	990	129	-.09	.11	1.03	0.4	1.07	0.4	.40
Q30	1992	294	-.17	.07	1.08	1.8	1.22	1.6	.34
Q41	990	154	-.37	.11	1.14	2.1	1.42	2.3	.34
Q39	1958	344	-.48	.07	1.18	4.0	1.42	3.4	.29
Q34	1983	611	-1.52	.06	.92	-2.6	.73	-4.7	.46
Q36	1985	637	-1.61	.06	.94	-1.9	.91	-1.4	.44
Q27	1993	715	-1.86	.06	1.04	1.2	.96	-0.8	.37
Q33	1983	1285	-3.56	.05	.97	-1.3	.87	-1.5	.29
Q26	1993	1549	-4.37	.06	1.13	4.3	1.54	3.3	.14
Mean	1516	369	.00	.13	.98	0.0	.92	-0.4	
SD	497	444	2.12	.10	.12	2.1	.43	2.3	

severe conditions and behaviors incorporated in the 12-month scale were not measured in the 30-day time frame in the CPS Supplement. The 30-day measures thus focus on reductions of food intake and related indicators of hunger, providing little information on food insecurity with no hunger evident. The broader range of the 12-month scale makes it likely to be more useful both in describing the conditions of the population at a point in time and in monitoring changes.

Statistically, Chapter Three will show that the 30-day scale is considerably less reliable than the 12-month scale in its ability to discriminate between households at varying levels of

Exhibit 2-12

NUMBER OF QUESTIONS ANSWERED: QUESTIONS IN THE 30-DAY SCALE

Number of Responses	Frequency	Percent	Cumulative Frequency	Cumulative Percent
2	7	0.0	7	0.0
3	1	0.0	8	0.0
4	6	0.0	14	0.1
5	2	0.0	16	0.1
6	10	0.1	26	0.1
7	17	0.1	43	0.2
8	35	0.2	78	0.4
9	10369	56.3	10447	56.8
10	1	0.0	10448	56.8
11	2	0.0	10450	56.8
13	1	0.0	10451	56.8
15	16	0.1	10467	56.9
16	15	0.1	10482	57.0
17	7922	43.0	18404	100.0

food insecurity. This more limited reliability stems mainly from the smaller number of independent questions asked in the 30day time frame. The 30-day scale has just nine independent items, and a total of 17 when follow-up items are included." The 12-month scale has 15 independent questions, plus three follow-up items. In addition, the absence of questions measuring the less severe food insecurity conditions creates a situation in which an extremely small proportion of the population gives affirmative responses to any of the items, which makes it more difficult for the scale to discriminate reliably among different levels of food insecurity.

For these reasons, the main report of this study focuses almost exclusively on the 12-month scale, and this report provides less detail on the 30day than the 12-month scale. Estimates of the prevalence of hunger based on the 30day scale are presented in Appendix B.

[11] The primary question typically asks if a particular behavior or condition occurred in the past 30 days. If the response is affirmative, the follow-up question then asks on how many of the 30 days the behavior or condition occurred.

Exhibit 2-13

FREQUENCY DISTRIBUTION OF HOUSEHOLD VALUES ON THE **30-DAY** SCALE

Scale Values	Frequency	Percent	Cumulative Frequency	Cumulative Percent
-5.62	16309	89.2	16309	89.2
-4.69	261	1.4	16570	90.6
-4.63	288	1.6	16858	92.2
-3.5	239	1.3	17097	93.5
-3.39	246	1.3	17343	94.8
-2.66	123	0.7	17466	95.5
-2.45	96	0.5	17562	96.0
-2.01	113	0.6	17675	96.7
-1.68	144	0.8	17819	97.5
-1.47	67	0.4	17886	97.8
-1	57	0.3	17943	98.1
-0.97	69	0.4	18012	98.5
-0.56	34	0.2	18046	98.7
-0.25	59	0.3	18105	99.0
-0.14	25	0.1	18130	99.2
0.27	23	0.1	18153	99.3
0.57	47	0.3	18200	99.5
0.68	9	0.0	18209	99.6
1.11	5	0.0	18214	99.6
1.57	5	0.0	18219	99.6
1.7	24	0.1	18243	99.8
2.08	4	0.0	18247	99.8
2.62	31	0.2	18278	100.0
2.66	2	0.0	18280	100.0
3.39	3	0.0	18283	100.0
4.44	1	0.0	18284	100.0
5.32	1	0.0	18285	100.0

2.4 SUMMARY

The scale development process involved five main steps:

- Exploratory linear factor analysis replicating key elements of prior research, which indicated that the response patterns and relationships in the CPS Food Security Supplement were largely similar to those seen previously.

- Estimation of two-parameter non-linear models, which indicated that a one-factor solution would be appropriate.

- Preliminary estimation of one-factor Rasch models on a one-fourth random subsample of the full CPS sample, resulting in the specification of an 18-item set for inclusion in the 12-month scale and a 17-item set for the 30-day scale.

- Tests of invariance of the model across other random subsamples of the full population and across three demographic subgroups (households with children, households without children but with elderly members, and households with neither children nor elderly members), which indicated that the models were quite invariant across groups.

- Estimation of the final scales on the full CPS sample.

Subsequent chapters of this report detail the steps taken to test the scales for reliability, construct validity, and estimation bias. Primary attention is given to the 12-month scale, which appears more useful than the 30-day scale on both conceptual and statistical grounds.

CHAPTER THREE
RELIABILITY ESTIMATES FOR THE FOOD SECURITY SCALES

Whenever an instrument is used to measure some quality of a person — whether it be a heart rate, a psychological profile, or a level of food insecurity — researchers want to be assured that the instrument is reliable. A reliable instrument is one that, if it were administered to the same individual on two occasions under similar conditions, would provide similar results in both tests. Reliability indices therefore attempt to measure the degree to which an individual's score is expected to remain stable (relative to other individuals' scores) over repeated occasions using the same instrument.

Often it is not feasible to administer an instrument repeatedly to the same individuals under similar circumstances. Reliability indices have therefore been developed that attempt to approximate this result through a single administration of the instrument. Most reliability indices for multi-item scales attempt to provide an estimate of the ratio of the true score variance to the total variance for a particular instrument. The underlying concept is that an individual's score on a scale (x) is composed of the individual's "true" score (t) and an error component. A general equation for a measure indicating the reliability of a scale (ρ) can be written as:

$$\rho = \frac{\sigma_t^2}{\sigma_x^2}$$

where σ_t^2 is the variance of the households' true scores and σ_x^2 is the variance of the observed measure (i.e., the household scores on the scale).

There are a number of reliability indices available for characterizing the reliability of a measure. Because the food security scales are estimated using a Rasch modeling approach, the most appropriate index is the Rasch reliability index. Because the Rasch reliability index has not been used as often in the scale development literature as some other reliability estimators, however, we provide estimates using some of the more common reliability indices as well as the Rasch reliability index to characterize the reliability of the food security scale.

One major difference between the more traditional reliability indices and the Rasch reliability index is the treatment of cases with extreme scores. Cases with extreme scores are

those with either the maximum or minimum score possible on the measure (i.e., those that have responded affirmatively to all questions in the scale, or negatively to all questions). When scale scores are normally distributed over a population, very few cases have extreme scores and consequently they have very little impact on the reliability estimate. When the distribution is severely skewed, however, the treatment of cases with extreme scores can have a major impact on reliability estimates. This is very relevant to the food security scales, because over 80 percent of the population has the lowest possible score on the 12-month scale and over 90 percent on the 30-day scale.

Because of differences in estimation algorithms, the Rasch reliability estimate always decreases when extreme scores are included, whereas the more traditional reliability estimates always increase. The Rasch model typically provides two reliability estimates, one including and one excluding the cases with extreme scores. The conventional practice with the more traditional reliability indices is to include the extreme scores. The discussion below' provides separate reliability estimates that include and' exclude extreme scores. In general, the estimate excluding households with extreme scores can be taken as indicating the reliability of the scale in measuring the severity of food insecurity and hunger among households that have experienced at least one of the food insecurity or hunger conditions represented in the scale. The interpretation of the estimate when extreme scores are included is less clear.

Among the more traditional indices, Nunnally (1978) recommended that at least two types of reliability coefficients be reported: correlations between alternate test forms, and coefficient alpha. The discussion below presents the results using three traditional reliability indices, two of which are based on the correlation between alternate test forms (the Spearman-Brown split-half reliability estimate, and Rulon's split-half reliability estimate), and Cronbach's alpha. All three reliability indices are based on the use of linear composites, and therefore do not correspond exactly to the Rasch model (a non-linear model). Nonetheless, the indices provide a general indication of the reliability of the scale and familiar measures that may be compared to other work.

3.1 SPEARMAN-BROWN SPLIT-HALF RELIABILITY ESTIMATES

The general form of the Spearman-Brown prophecy formula can be written as:

$$\rho_{sp} = \frac{k\rho_{ii'}}{1 + (k-1)\rho_{ii'}},$$

where ρ_{sp} represents the reliability of the composite measure with k parallel tests, and ρ_{ii} represents the reliability of any one particular test. A simplified form of the equation can be written as:

$$\rho_{sp} = \frac{2\rho_{ab}}{1 + \rho_{ab}},$$

where ρ_{ab} represents the correlation coefficient between two parallel tests.

In order to create two somewhat parallel tests, the item pool (i.e., all the items used in the scale) is typically split in half randomly. Each subset of the items is considered a separate scale, and the results of the two scales are compared. When the number of available items is small, as in the present situation, a commonly used method is to order the items in terms of severity and assign odd-numbered items to one test and even-numbered items to another test. The two new scales should have the same number of items, so if the item pool contains an odd number of items, one is dropped before the pool is split.

To estimate ρ_{sp} for the 12-month scale, it was necessary to drop dependent items in order to generate unbiased reliability estimates. [1] It was also considered informative to generate reliability estimates separately for items that were administered only to households with children and for items that were administered to all households.

For households with children, there were 15 independent items available to create two parallel measures. Because there were an odd number of items, the most severe item was dropped from the list. For the first parallel scale, households' responses to items 43, 28, 38, 57, 56, 58, and 54 were summed to create the household score. For the second parallel scale, items 47, 40, 35, 32, 24, 55, and 53 were summed. Based on the correlation between

[1] **Dependent items are those that are follow-ups to previous items. A number of items in the food insecurity scales have an initial question (e.g., did this situation occur within the past 12 months?) and a follow-up (e.g., in how many of the past 12 months did the situation occur?)**

household scores on these two scales, the Spearman-Brown reliability estimate for the total scale was .852 with extreme scores excluded (see Exhibit 3-l). Including extreme scores raises the reliability index to .903.

Exhibit 3-l

SUMMARY OF RELIABILITY ESTIMATES USING TRADITIONAL INDICES

Household Type	Reliability Estimate	Extreme Scores Included	Extreme Scores Excluded
12-Month Scale			
All households	Spearman	.899	.794
	Rulon	.932	.878
	Alpha	.856	.743
Households with children	Spearman	.903	.852
	Rulon	.899	.813
	Alpha	.882	.814
30-Day Scale			
All households	Spearman	.840	.357
	Rulon	.888	.650
	Alpha	.789	.356
Households with children	Spearman	.852	.530
	Rulon	.844	.530
	Alpha	.799	.555

For all household types (i.e., households with any combination of either children, adults, and elderly), there were eight independent items available to create two parallel measures. For the first parallel scale, items 28, 35, 24, and 54 were summed. For the second parallel scale, items 38, 32, 55, and 53 were summed. The reliability estimate for the total scale is .794 with extreme scores excluded, and .899 with extreme scores included.

For the 30-day scale, the reliability estimate for households with children is .530 and the reliability estimate for all households is .357 with extreme scores excluded. Including extreme scores generates a striking increase in the reliability estimates, to .852 for households with children and .840 for all households.

Note that, although including cases with extreme scores increases the reliability estimate for both scales, the effect is particularly striking for the 30-day scale. This occurs for three reasons.

First, the number of items in the paired subscales is smaller for the 30-day scale. The 30-day scale contains just five independent items that apply to all households, and ten that apply to households with children. This means that the split-half scales each contain just two items in the analysis for all households, and five in the analysis of households with children. In contrast, the split-half 12-month scales contain four items for the analysis of all households and seven items for the analysis of households with children. Smaller numbers of items in general lead to lower reliability estimates.

The second factor is that the 30-day scale measures a narrower band of the spectrum of food insecurity than the 12-month scale. The least severe items in the 12-month scale were not asked in the 30-day time frame. This means that the 30-day scale not only contains fewer items, but that the scale is attempting to make distinctions within a narrower range than the 12-month scale. In effect, this means that the 30-day scale faces a more difficult challenge in distinguishing the varying levels of food insecurity and hunger among those households that have experienced one or more of the conditions measured.

The final distinction between the scales is that a far greater proportion of households answered negatively to all items on the 30-day scale than the 12-month scale (89 percent vs. 57 percent of households that passed the screening questions). Thus, including or excluding the households with extreme scores will have a greater effect on the 30-day than the 12-month scales.

3.2 RULON'S SPLIT-HALF RELIABILITY ESTIMATES

Rulon proposed an alternative method for estimating the reliability of a scale using the split-half tests. [2] The method involves estimating the difference between household scores on two parallel tests and estimating the ratio of the variance of the difference score to the variance of the total score. The equation for Rulon's method is written as:

[2] Rulon, P.J., "A Simplified Procedure for Determining the Reliability of a Test by Split Halves," *Harvard Educational Review* vol. 9, pp. 99-103, 1939.

$$\rho_{sh} = 1 - \left[\frac{\sigma_D^2}{\sigma_x^2}\right],$$

where σ_D^2 is the variance of the difference score and σ_x^2 is the variance of the total score.

To estimate the index, we used the same subsets of items described above for the Spearman test, again performing the computation both for households with children and for all households (see Exhibit 3-l). For the 12-month scale, the reliability estimate for households with children is .813 and the estimate for all households is .878 with extreme scores excluded. When extreme scores are included, the estimates increase to .899 for households with children and .932 for all households.

For the 30-day scale, the reliability estimate for households with children is .530 and the reliability estimate for all household types is .650 when extreme scores are excluded. Including the extreme scores raises the estimates to .844 and .888, respectively.

3.3 CRONBACH'S ALPHA RELIABILITY ESTIMATES

Cronbach's alpha and Kuder Richardson 20 (McDonald, 1985) produce identical results when using independent items that are dichotomous in form. Therefore, for the 12-month scale, these two equations are interchangeable. For simplicity, we will refer to Cronbach's alpha when describing these reliability estimates.

Cronbach's alpha was developed to circumvent problems associated with the non-random selection of subsets of items when using methods such as the Spearman-Brown or Rulon methods. Cronbach's alpha, α_{xx}, can be written as:

$$\alpha_{xx} = \left[\frac{k}{(k-1)}\right] \cdot \left[1 - \left[\frac{\Sigma\sigma_i^2}{\sigma_x^2}\right]\right],$$

where k represents the number of items in the test, σ_i^2 represents the variance of item i, and σ_x^2 represents the variance of the total test score. Alpha is considered to be the lower bound of the true theoretical reliability estimate, the coefficient of precision.

The overall reliability estimates, summarized in Exhibit 3-1, are similar to those seen with the prior tests. With extreme scores excluded, the values of α for the 12-month scale are .814 for households with children and .743 for all households. Including the households with extreme scores raises the estimates to .882 for households with children and .856 for all households.

For the 30-day scale, the α values are .555 for households with children and .356 for all households when cases with extreme values are excluded. When households with extreme values are included, the values are ,799 for households with children and .789 for all households.

In addition to assessing the reliability of the total scale, Cronbach's alpha is often used to examine the appropriateness of including individual items in the scale. The usual rule is that if α_{xx} increases substantially when an item is removed from the scale, the item should be considered for removal. It is also possible to evaluate how the reliability of the scale changes when any one item is removed from the scale. Exhibits 3-2 and 3-3 show that in nearly all instances, removing an item would reduce the estimated reliability of the scale. The only potential exception would be item 53;[3] removing this item would generate a small increase in the reliability estimate with extreme scores excluded, but the loss of information at the end of the scale would be more detrimental to scale validity tban is justified by this small increase in reliability.

3.4 RASCH MODEL RELIABILITY ESTIMATES

The Rasch reliability indices behave in a slightly different manner and yield somewhat lower estimates of reliability than the more traditional indices presented above. The reliability index for the Rasch Scale is defined as:

$$\rho_r = \frac{(\sigma_x^2 - MSE)}{\sigma_x^2}$$

[3] Removing item 28 with extreme scores included also generates an increase in α, but the difference is tiny (measured in the third decimal).

Exhibit 3-2

CRONBACH'S ALPHA FOR THE 12-MONTH SCALE FOR HOUSEHOLDS WITH CHILDREN

Item	Extreme Scores Included (α = .882; n=7,888)			Extreme Scores Excluded (α = .814; n=4,278)		
	Item Mean	Correlation with Total Score	α with Item Deleted	Item Mean	Correlation with Total Score	α with Item Deleted
43	.017	.338	.882	.028	.309	.812
47	.033	.433	.879	.057	.415	.806
28	.036	.397	.880	.063	.354	.809
40	.037	.433	.879	.064	.408	.806
38	.040	.429	.879	.071	.394	.806
35	.081	.565	.873	.146	.529	.796
57	.098	.587	.872	.177	.540	.795
32	.179	.669	.867	.327	.567	.791
56	.183	.664	.867	.333	.556	.793
24	.182	.642	.868	.332	.522	.796
58	.288	.656	.868	.528	.441	.804
55	.290	.709	.865	.532	.528	.796
54	.338	.692	.866	.621	.462	.801
53	.450	.607	.873	.827	.221	.818

where ρ_r is the reliability index, σ_x^2 is the variance of the scale, and MSE is the mean square error of the scale. Like the previously described reliability indices, ρ_r is intended to represent the proportion of total variance in household scores that is caused by variance in households "true" scores.

In Exhibit 3-4, the reliability estimates for the **12-month** and **30-day** scale are presented. Separate estimates are presented for two treatments of the variables that involve follow-up questions. For example, the **12-month** scale includes an item that indicates that adults have cut or skipped meals in the past 12 months, and a second (answered only by people who responded positively to the first item) that indicates that meals were cut or skipped in three or more months. In one treatment, these are considered as independent dichotomous items. **In the**

Exhibit 3-3

CRONBACH'S ALPHA FOR THE **12-MONTH** SCALE FOR ALL HOUSEHOLDS

	Extreme Scores Included (α = .856; n=18,179)			Extreme Scores Excluded (α = .743; n=7902)		
Item	Item Mean	Correlation with Total Score	α with Item Deleted	Item Mean	Correlation with Total Score	α with Item Deleted
28	.034	.434	.858	.080	.429	.727
38	.040	.459	.855	.092	.451	.723
35	.072	.594	.842	.167	.582	.695
32	.149	.701	.827	.343	.595	.686
24	.157	.682	.829	.362	.545	.697
55	.257	.678	.830	.591	,373	.736
54	.276	.725	.823	.635	.439	.721
53	.349	.646	.837	.803	.206	.760

Exhibit 3-4

RASCH RELIABILITY ESTIMATES
FOR THE **12-MONTH** AND **30-DAY** SCALES

Scale	Model Type	Including Households with Extreme Scores	Excluding Households with Extreme Scores
12-month scale	Dichotomous	.63	.74
	Trichotomous	.58	.70
30-day scale	Dichotomous	.00	.57
	Trichotomous	.00	.44

second treatment, they are combined into a single trichotomous item (no meals cut/skipped in past **12** months; meals cut/skipped in one or two months; meals cut/skipped in three or more months). Treating such question sets as trichotomous items reduces the number of items in the scale, and hence reduces the estimated reliability.

With extreme scores excluded, the reliability estimates for the **12-month** scale are **.74** (dichotomous) and **.70** (trichotomous). The reliability estimates for the 30-day scale are **.57** and **.44.**

Unlike the previous reliability indicators, the Rasch reliability estimate decreases when extreme scores are included. Thus, the reliability estimates for the 12-month scale are .63 and .58 with the extreme scores included. For the 30-day scale, because 88 percent of the households that passed the screener responded negatively to all questions, the reliability estimate falls to zero when cases with extreme scores are included.

3.5 RELIABILITY IN IDENTIFYING CASES WITH NO FOOD INSECURITY CONDITIONS

As noted earlier, none of the reliability statistics deal adequately with situations in which a large percentage of cases have extreme scores. For present purposes, then, the statistics are primarily useful in indicating the scales' reliability in distinguishing the level of food insecurity among households that experience at least one of the conditions measured by items included in the scales. The statistics provide little information about the scales' reliability in distinguishing between households that experience none of the food insecurity conditions measured and households that experience one or more of the conditions.

To provide additional insight on this point, a further analysis was conducted. The analysis follows the split-half procedure: for each scale, we separate the items into two groups to constitute two new scales; we then examine the relationship between the two new scales. The scales are split as described earlier, but each of the new scales is then collapsed into a dichotomous variable. The two categories on the dichotomous variable are (1) "answered all questions negatively, " and (2) "answered one or more questions positively." The agreement between the new dichotomous items is then assessed.

A simple test of correspondence is the percentage of cases classified similarly by the two variables. When the population is unevenly divided between the two categories of the dichotomous variables, however, a high rate of agreement can occur by chance. The more appropriate test is therefore the Kappa statistic. The Kappa statistic is a measure of the extent **to which there is agreement above and beyond what would be expected by chance. Kappa** *(K)* is computed as:

$$\frac{\textit{(percent observed agreement)} - \textit{(percent agreement expected by chance alone)}}{100\% - \textit{(percent agreement expected by chance alone)}}$$

To test the hypothesis $H_0: \kappa = 0$ vs. $H_1 : \kappa > 0$, we can use the lambda statistic $\lambda = \frac{\kappa}{se(\kappa)}$. A formula for the estimation of the standard error of κ can be found in Rosner (1986).

Landis and Koch (1977) suggested that a κ below 0.4 represents poor agreement, between 0.4 and 0.75 represents good agreement, and greater than 0.75 represents excellent agreement.

The percent agreement between paired subscales and the Kappa statistics are shown in Exhibit 3-5. As expected, the two scales in each pair are in agreement in a high percentage of cases-around 85 percent for the 12-month scale, and around 95 percent for the 30-day scale. More importantly, the κ values are all close to .70, which is toward the high end of the range representing "good" agreement.[4]

Exhibit 3-5

LEVEL OF AGREEMENT BETWEEN DICHOTOMIZED SPLIT-HALF SCALES

	Households with Children		Households without Children	
	Percent Agreement	κ	Percent Agreement	κ
12-month scale	84.8%	.70	85.8%	.69
30-day scale	94.5%	.68	95.1%	.67

This suggests that the scales provide a reasonable level of reliability in distinguishing between households that have experienced any of the measured facets of food insecurity and households that have not experienced any of these conditions. It is particularly worth noting that the κ statistics for the 30-day scale are quite similar to those for the 12-month scale, even though the 30-day subscales have very few items and a very high percentage of respondents answering all questions negatively. These factors appear to reduce the 30-day scale's reliability in discriminating among households that have experienced one or more of the measured conditions, but the scale remains reasonably strong at distinguishing those that have experienced any of the conditions from those that have not.

[4] In all of the comparisons, the λ statistic indicates that the level of agreement is significantly greater than would be expected by chance ($p < .001$).

3.6 *SUMMARY*

Although there is no absolute rule regarding minimum acceptable levels of reliability, the literature provides at least some rough guidelines. Nunnally (1978), writing in the context of the more traditional measures of reliability, suggests that reliabilities of about .70 can be sufficient to suggest general reliability, particularly in the early stages of measurement development. Nunnally suggests that for basic research, requiring a very high reliability (e.g., above .80) can be counterproductive, as resources are devoted to improving the scale instead of learning about the underlying phenomenon. He also argues, however, that scales used to support decisions regarding the treatment of specific individuals should have reliabilities exceeding .90.

Using the three traditional measures and following the conventional practice of including households with extreme scores, both the 12-month scale and the 30-day scale would be judged quite reliable. Estimated reliability values range from .86 to .93 for the 12-month scale, and from .79 to .89 for the 30-day scale.

As noted previously, however, this conventional approach yields statistics that can be influenced by the type of highly-skewed distributions that characterize the food insecurity scales. A more conservative approach is to separate two types of reliability. The first considers the scale's reliability in describing the level of food insecurity among households that experience one or more of the food insecurity or hunger conditions measured by items in the scale. The second asks about the scale's reliability in distinguishing between households that have *vs.* have not experienced any of the measured food insecurity or hunger conditions.

The 12-month scale fares quite well on both dimensions of reliability. When households that answered all questions negatively are excluded from the analysis, the Rasch reliability estimate ranges from .70 to .74, and the more traditional indices range from .74 to .88. Using the dichotomous split-half test, the κ statistics are .69 to .70. Although this approach is novel, and no established benchmarks provide standards for "good" reliability, all of these scores are in the acceptable range for other uses of the statistics.

The 30-day scale is equally reliable at distinguishing households that have vs. have not experienced any of the measured food insecurity and hunger conditions. The κ statistics of .67 to .68 are nearly the same as those for the 12-month scale. The 30-day scale, however, seems less reliable at distinguishing among levels of food insecurity for households that experience one

or more of the measured conditions. When we consider only the households that answered at least one question affirmatively, reliability estimates range from .36 to .65.

Two factors reduce the 30-day scale's estimated reliability in distinguishing levels of food insecurity and hunger among households that experience one or more of the measured conditions. First, the number of independent items on the 30-day scale is small. Second, the 30-day scale measures a narrower range of food insecurity, because some of the less severe questions were not asked in the 30-day time frame. To increase the reliability of the 30-day scale to be more comparable to the 12-month scale, it would probably be necessary to add more 30-day items to the Food Security Survey, and in particular to add items measuring less severe conditions of food insecurity than those currently included in the scale.

CHAPTER FOUR
DEFINING RANGES OF THE FOOD SECURITY SCALE

The analyses discussed in earlier chapters provide the basis for concluding that food security can be reliably measured as a umdimensional phenomenon. Households can be ranked on the basis of scale values across a continuous range indicating the severity of food insecurity experienced within the household. The full range of severity measured extends from no measurable food insecurity at all, through increasing levels of severity characterized by reduced food intake and hunger for household members, to some maximum measured level. Although the phenomenon of food insecurity can be viewed as unidimensional and continuous, several distinct ranges of severity are of interest. Identifying these ranges of severity enables one to supplement the continuous food security scale, subdividing it to create a categorical variable providing a comparatively simple measure of food security status in terms of several broad ranges of severity.

In this chapter we describe the conceptual and empirical bases for ***apriori*** expectations regarding the structure of a categorical food security status variable, and the process leading to definition of categorical ranges within the continuous food security scale. Several specific issues related to selection of threshold levels or scale dividing lines are summarized, and the final categorical food security status variable is described.

4.1 CONCEPTUAL BASIS FOR A CATEGORICAL FOOD SECURITY STATUS VARIABLE

The first threshold level of severity, or dividing line, to be identified on the unidimensional food security scale is the point of transition from food secure status to food insecure status. In addition to this threshold, two other cutpoints, deriving from the LSRO/AIN conceptual definitions of food security, food insecurity, and hunger, are of interest. [1] As noted

[1] The conceptual rationale underlying the measurement of food insecurity and hunger developed in the present study is described in Bickel, Andrews and Klein (1996). The research background leading to this measurement approach is documented in the U.S. Department of Agriculture report, ***Food Security Measurement and Research Conference: Papers and Proceedings,*** Alexandria, VA: USDA Food and Consumer Service, Office of Analysis and Evaluation, June 1995.

in the main report of this study,[2] the LSRO/AIN conceptual clarification provides a working definition of hunger as "the uneasy or painful sensation caused by a lack of food" and identifies hunger as "a potential but not necessary consequence of food insecurity" (Anderson/LSRO, 1990). Previous studies examined by the AIN expert group had led to a consensus view of hunger as "nested" within the broader phenomenon of food insecurity, and occurring at the more severe levels of food insecurity as experienced in U.S. households.

Moreover, empirical evidence supports the conceptual view of household-level food insecurity as a managed process involving identifiable patterns or stages of behavioral responses to food insufficiency as the degree of such insufficiency increases (Radimer, Olson and Campbell, 1990; Basiotis, 1992; Cristofar and Basiotis, 1992; Radimer et *al.,* 1992; Wehler, Scott and Anderson, 1992; Burt, 1993; Cohen, Burt and Schulte, 1993). Within this framework, food insecurity in the household begins with an initial stage characterized by adult household members' experiences of food insufficiency, anxiety about their food situation, and adjustments in their budget and food management patterns. These latter behavioral "coping strategies" may involve efforts to augment the household's food supply from emergency or other non-normal sources, and may involve modifications to the variety and quality of food available to household members, but normally do not include reduction in overall quantity of food intake. In this initial stage there is little or no evidence that household members experience actual hunger — "the uneasy or painful sensation caused by a lack of food" — as a result of their household's level of food insecurity.

The second stage involves intensification of food economizing behaviors, some of which lead to patterns of reduced food intake among one or more of the adults in the household. When children are present in a household, efforts are made to spare them from food intake reduction through various rationing strategies. If the household's food insecurity persists or worsens, however, a third stage appears in which adult hunger is manifested in more severe forms (e.g., going whole days with no food) and, in households with children, the children experience actual hunger, revealed in patterns of reduced food intake.

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[2] Hamilton *et al.* (1997), ***Household Food Security in the United States in 1995: Summary Report of the Food Security Measurement Project,*** Alexandria, VA: U.S. Department of Agriculture, Food and Consumer Service, June 1997, Chapters One and Two.

This conceptual framework suggests four potentially identifiable stages or levels of severity within the continuous food security variable. Those severity-level categories are: (1) Food Secure; (2) Food Insecure with No Hunger Evident; (3) Food Insecure with Moderate (adult) Hunger Evident; and (4) Food Insecure with Severe Hunger (child hunger, and severe adult hunger) Evident. Given these conceptual categories, the question is how best to subdivide the 12-month and 30-day scales into ranges of severity that correspond operationally to the designated conceptual categories.

4.2 DEFINING RANGES AND SELECTING SCALE CUTPOINTS

As described in earlier chapters, the Rasch model assigns a scale value to each household based on the number of scale items answered affirmatively relative to the total number of items answered.[3] As an interdependent part of its estimation from the data, the model also ranks scale items according to their level of severity on the basis of the actual response patterns of all households in the data. The 18 items in the final 12-month scale are shown in Exhibit 4-1, with items listed by increasing order of severity from top to bottom in the table. If all responses were perfectly ordered, an affirmative response to any scale item would occur only in conjunction with affirmative responses to all prior, or less severe, scale items. Therefore, as perfect scale ordering is approached among the actual sample households, any number "*n*" of affirmative responses approaches exact correspondence to the first *n* items in the scale. Although the data are not perfectly ordered for all households, in fact the most common pattern of household responses (the mode) does follow the sequential order of severity.[4] That is, the

[3] For ease of explication this discussion is presented without addressing separately the cases of households with and without children. Readers should note that these two types of households were presented different numbers of items, because questions addressing conditions of children in the household were not presented to households without children. The form of the Rasch measurement model and the BIGSTEPS software that implements the model take these differences into account in calculating household scale scores.

[4] For example, among households with no children, 82 percent followed the modal pattern on the 12-month items. Households answering "no" to all questions, however, amount to 65 percent of the total. Among households answering "yes" to at least one question, 49 percent followed the modal pattern. For the non-modal households, responses deviate from the pattern that would be observed under perfect ordering. Some households answer "yes" to items without answering "yes" to all prior items. A non-modal household with *n* affirmatives has answered negatively one or more of the *n* less-severe questions, instead affiiing one or more of the more severe questions. The Rasch model implicitly considers them equivalent, in effect treating all households as modal and assigning both households the same scale value.

modal household that answers *n* items affirmatively gives "yes" responses to the *n* least severe items in the scale sequence.

Defining ranges on the continuous scale is the operational means of assigning values to the categorical variable measuring households' food security status. This categorical measure identifies the particular range of severity of food insecurity that a given sample household has experienced in the prior 12-month or 30-day period. Defining the appropriate scale ranges for classifying households according to food security status involves identifying subsets of the sequential indicator items that best correspond to the conceptual categories described above. After a subset is identified in general terms, it is necessary to identify the appropriate classification boundaries, or points of transition from one severity range to the next. Each such boundary is marked by a particular "threshold item. " The threshold items and their classification boundaries developed in the present study for the purpose of giving operational definition to the categorical food security status variable are depicted by the shaded rows in Exhibit 4-2.[5]

Thus, the scale itself, with items ranked from least to most severe, provides a meaningful framework within which to identify operationally the designated ranges of behaviors and conditions corresponding to the conceptual construct summarized above. The scale, whose values range from 0 to 10, must be subdivided in terms of numeric values so that a household with a particular scale value can be assigned to a particular food security status category. This subdivision, however, can be accomplished by considering the behaviors and conditions represented by values at each point on the scale.

The procedure for subdividing the scale rests on two features of the scaling methodology described above. First, household values on the food security scale are based fundamentally on a simple count of the number of questions to which they respond affiiatively. Second, most households' responses follow the sequential logic of item severity: a household that says "yes" to a particular question typically says "yes" to all less severe questions as well.

In general, then, one can characterize households that have a particular scale value as having responded affiatively to a particular group of questions. Exhibit 4-2, which is organized in terms of increasing severity of the questions, illustrates the point. A household that

[5] Exhibits *4-I* and *4-2 in the* main report of this study (Hamilton *et al.,* 1997), also illustrate this division of the scaled indicator items into the respective severity-level classes of the categorical food security measure.

Exhibit **4-1**

ITEMS IN THE FINAL **12-MONTH** SCALE LISTED BY INCREASING SEVERITY LEVEL

Item Label	**Item Content (All questions refer to the last 12 months)**
Q53	Household members worried whether food would run out before they got money to buy more (sometimes or often).
Q54	Respondent reports that the food they bought just didn't last, and they didn't have money to get more (sometimes or often).
Q55[a]	**Household members couldn't afford to eat balanced meals (sometimes or often).**
Q58	Household relied on a few kinds of low-cost foods to feed children because they were running out of money to buy food (sometimes or often).
Q24	Adults in the household cut the size of meals or shipped meals because there wasn't enough monev for food.
Q56	Household couldn't afford to feed children a balanced meal, because they couldn't afford that (sometimes or often).
Q32	Respondent ate less than he/she felt they should because there wasn't enough money to buy food.
Q25[a]	**Adults in the household cut the size of meals or skipped meals because there wasn't enough money for food in at least 3 of the last 12 months,**
Q57	Children were not eating enough because household couldn't afford enough food (sometimes or often).
Q35	Respondent was hungry but didn't eat because couldn't afford enough food.
Q38	Respondent lost weight because there wasn't enough food.
Q40	Adults cut the size of children's meals because there wasn't enough money for food.
Q28[a]	**Adults in household did not eat for a whole day.**
Q47	Children were hungry but household couldn't afford more food.
Q29	Adults in household did not eat for a whole day in at least 3 of the last 12 mos.
Q43	Children skipped meals because there wasn't enough money for food.
Q44	Children skipped meals because there wasn't enough money for food in at least 3 of the last 12 mos.
Q50	Children did not eat for a whole day because there wasn't enough money for food.

[a] **Indicates threshold items in the scale. For each designated range of severity comprising the categorical food-security variable, the subset of indicators beginning with the threshold item and continuing through the successively more severe indicators, up to the next identified threshold, serve operationally to define and characterize that designated range.**

EXHIBIT 4-2

THRESHOLD ITEMS DEFINING RANGES OF THE FOOD SECURITY SCALE

Questions (in order of increasing severity)		Households with Children		Households without Children	
		Number of Affirmatives	Modal Household Value	Number of Affirmatives	Modal Household Value
		0	0.0	0	0.0
Q53	Worried food would run out	1	0.1	1	0.9
Q54	Food bought didn't last	2	1.6	2	2.0
Q55	Adult not eat balanced meals	3	2.3	3	2.8
Q58	Adult fed child few low-cost foods	4	2.8		
024	Adult cut size or skipped meals	5	3.3	4	3.6
Q56	Couldn't feed child balanced meals	6	3.8		
Q32	Adult eat less than felt they should	7	4.3	5	4.3
Q25	Adult cut size or skipped meals, 3+	8	4.7	6	5.0
Q57	Child not eating enough	9	5.2		
Q35	Adult hungry but didn't eat	10	5.6	7	5.8
Q38	Adult lost weight	11	6.0	8	6.5
Q40	Cut size of child's meals	12	6.4		
Q28	Adult not eat whole day	13	6.8	9	7.5
Q47	Child hungry	14	7.3		
Q29	Adult not eat whole day, 3+ mos.	15	7.8	10	10.0
Q43	Child skipped meal	16	8.4		
Q44	Child skipped meal, 3+ mos.	17	9.3		
Q50	Child not eat for whole day	18	10.0		

gives one affirmative answer most often answers Q53 affirmatively, a household with two affirmatives most often affirms Q53 and Q54, and so on.

For each question, the exhibit shows the number of affiative responses and the associated scale value for households whose responses follow the sequential logic of item severity. For example, if the most severe question affirmed by a household with children is Q24, that household has also responded affirmatively to the four less severe questions *(453,* Q54, Q55, and Q58) and has a total of five affirmative responses. Its corresponding scale score

is 3.3. The exhibit also shows parallel, but slightly different, values for a similar household without children. Q58 is not applicable to that household. Thus, if the most severe question it affirms is Q24, it will have a total of just four affirmative responses. Because the Rasch model, however, computes a scale value that takes into account the number and severity of the questions the household was asked, the scale value for the household without children (3.6) is quite close to the value for the household with children (3.3).

It is possible to describe any point on the scale in terms of the questions that the "modal" or typical household with that scale value has answered affirmatively. Similarly, one can say that all modal households with values at or above a specified point on the scale have responded affirmatively to ***at least*** the group of questions corresponding to the specified point. For example, all modal households with values at or above 2.3 have responded affirmatively to at least the three least severe questions in the scale (Q53, Q54, Q55). All modal households with values of 4.7 or higher have responded affirmatively at least to Q24 and to all applicable less severe questions.[6]

Thus, although the scale itself is a continuous measure of a single dimension (i.e., the severity level of food insecurity), it can be subdivided by considering the collection of conditions and behaviors associated with particular ranges of scale values. In this manner, the scale and the severity rankings provided by the Rasch model yield a statistical framework for defining conceptually meaningful categories for the food security status variable. Within this statistical framework, however, the exact location of the category boundaries or scale thresholds depends upon informed judgment about how best to interpret the conceptual constructs based upon the LSRO/AIN definitions and the previous empirical research findings on food security and hunger. The next section reviews those judgments and the reasoning behind them.

[6] Non-modal households with a given scale value have, by definition, not responded affirmatively to all of the applicable less severe questions, but instead have responded affirmatively to more severe questions. For example, a non-modal household (with children) with a scale value of 2.3 must have answered three questions affirmatively. Instead of Q53, Q54, and Q55, however — the three least severe questions — the household might have said "yes" to Q53, Q54, and Q58, although saying "no" to Q55.

4.3 EVIDENCE OF FOOD INSECURITY

The LSRO/AIN definitions of food security and food insecurity are:

- ***Food security:*** "Access by all people at all times to enough food for an active healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)" (Anderson/LSRO, 1990, p. 1598).

- ***Food insecurity:*** "Limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" ***(ibid.).***

Several dimensions or aspects of food security are apparent in these definitions, of which the most central and fundamental is described as "enough food for an active, healthy life" — i.e., a sufficient quantity of acceptable foods to meet the household's basic needs. A number of additional dimensions are also apparent, including the nutritional quality and safety of available foods, the social acceptability of the means of obtaining food, and the household's assurance or certainty of its ability to obtain needed food. These additional dimensions of the broad conceptual definition of food security, however, are not directly captured in the questions incorporated in the food security scale. Rather, the measure focuses on the simple: quantitative dimension of "enough" food. The food quality dimension is represented only to the extent that some particular quality of food (in both nutritional and conventional senses) is perceived and understood by households members to be necessary. The scale consists entirely of items indicating either this quantitative or qualitative aspect of food sufficiency, as experienced and understood by the household respondent, in relation to his or her self-perception of basic needs.

Several of the questions included in the CPS Food Security Supplement were intended to capture those aspects of households' food coping behaviors that seek to augment insufficient household food supply through emergency or other non-normal means. These extraordinary coping methods, such as obtaining food from food banks or pantries, borrowing money for food, taking children to others' homes for meals, or getting meals at soup kitchens, have been regarded as good behavioral indicators of a condition of food insecurity or insufficiency within the household, and they may be presumed to reflect the concept of acceptability of sources or means of food-acquisition within U.S. social norms. These food-augmenting coping behavior

items in the CPS data, however, do not factor together with the indicators that are included in the measurement scale. Thus, they represent a dimension of the conceptual definition of food security — the assurance of access to food through socially-acceptable means — that is not represented within the unidimensional measure of severity of food insecurity.'

Examining the items in the 12-month scale, shown in severity-ranked order in Exhibits 4-l and 4-2, the basic question is how many items must be answered affirmatively in order to provide clear evidence of food insecurity as defined above. Item Q53 could be interpreted as indicating uncertainty about the household's access to adequate acceptable food, or the ability to acquire it in socially acceptable ways. By itself, however, this subjective item may be considered to lack face validity as a sufficient indicator of food insecurity. An affirmative response to only this one item was therefore judged by the technical analysis team as **insufficient** to indicate the threshold level of food insecurity.

Giving affirmative responses to two items (in the modal case, items Q53 and Q54) indicates worry or anxiety about the household's food position, and also initial perceptions of insufficiency of the household's food supply (food bought just didn't last). Although these two items together provide stronger evidence of household food insecurity, they were still judged insufficient to establish unequivocally that severity has reached the threshold level required for the categorical measure of food insecurity. Including item Q55, however, captures not only reports that the household food supply is substandard, but also efforts to cope with this insufficient food supply in ways that, although they may maintain the quantity of food intake, reduce the perceived quality of diets below the level the respondent understands to be needed to maintain "balanced meals. "

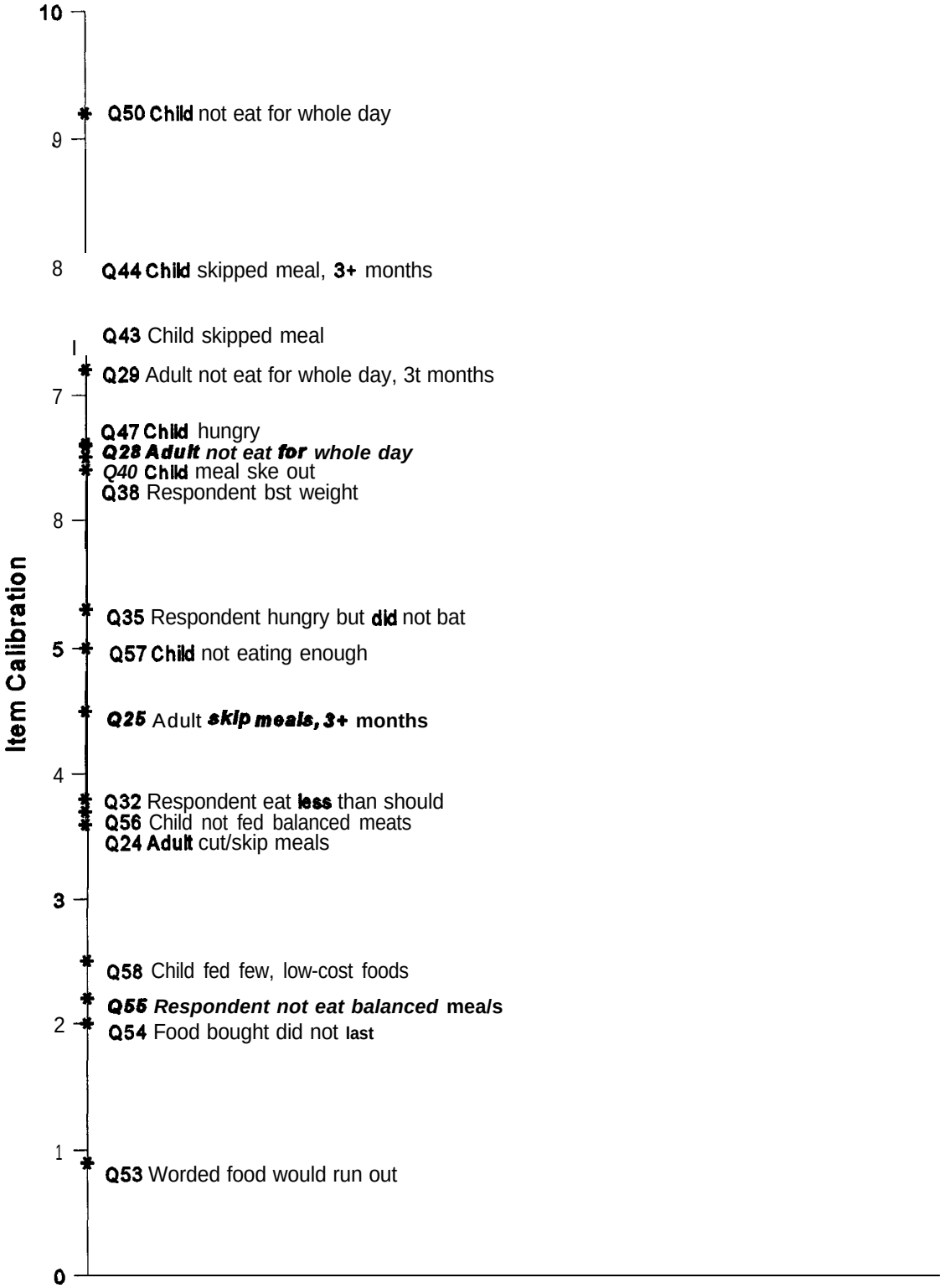
It is useful to consider the relative severity of items as well as the simple rankings shown in prior exhibits. Exhibit 4-3 therefore maps the relative severities, using the item calibrations presented in Chapter Two.

The three least-severe items in the scale (453, Q54, and Q55) appear just prior to a substantial gap in the spacing of item calibrations, indicating a large difference in severity between these items and the group comprised by items Q24, Q56, and Q32. Although item Q58 (child fed few low-cost foods) is very close in severity to the item Q55 and consistent in

[7] See Chapter Five for further discussion of these indicators of coping behaviors.

Exhibit 4-3

SEVERITY RANKING OF QUESTIONS IN FOOD SECURITY SCALE



Note: Item calibrations show relative severity of questions from 0.9 (least severe) to 9.2 (most severe). Highlighted items represent the threshold for categories of the food security status indicator.

conceptual content, selection of the threshold or **cutpoint** item aims at identifying the point of transition from food security into food insecurity. Thus, the first item completing a group that is conceptually and statistically consistent with food insecurity was judged most appropriate for identifying the threshold. Item **Q55** meets this criterion, and the set of three household- or adult-level items answered affirmatively by modal households responding "yes" to item **Q55**, taken together, was judged to provide sufficient evidence that the household has experienced food insecurity, although at a level not yet showing evidence of actual hunger among household members.

4.4 SUBJECTIVE REPORTING OF HUNGER

As summarized above, this research has aimed to develop both a continuous measure of severity and a broad categorical measure of resource-constrained food insecurity that can differentiate three broad ranges of severity, the two most severe of which involve actual hunger for household members. This measurement task is guided by the **LSRO/AIN** conceptual definitions of food insecurity and hunger, where hunger is nested as "a potential but not necessary consequence" of food insecurity, and is defined as "the uneasy or painful sensation caused by a lack of food." Therefore, an essential measurement task is to identify households whose members have experienced actual hunger — the "uneasy or painful sensation caused by a lack of food" — as a result of constrained or insufficient household financial resources. Food insecurity or hunger resulting from eating disorders, dieting, or causes other than household resource constraints are not being measured.

Three related factors enter into the conceptual consideration of what constitutes the specific phenomenon being measured. These are access to adequate food, the physiological sensation of hunger, and potential malnutrition. The relationships between the first two of these — the basic dimension of food insecurity and hunger as experienced within households — constitute the focus of the present research. The relationship of this basic experiential dimension to malnutrition (which is also defined as nested — a "potential but not necessary consequence" — within food insecurity) is not addressed in this research.

All items in the CPS Food Security Supplement addressing aspects of food insecurity or hunger contain explicit language making it clear to respondents that the condition being asked about is specifically caused by constrained household financial resources. For example, item

Q53 states "I/We worried whether (my/our) food would run out before (I/we) got money to buy more." Item Q54 states "The food (I/we) bought just didn't last, and (I/we) didn't have money to get more, " whereas item Q55 states "(I/We) couldn't afford to eat balanced meals." Such qualifying language is included consistently in all food insecurity and hunger items in the CPS instrument, including all those appearing in the food security scales. As a result, within the limits of unidentifiable measurement error, affirmative responses to scale items can be expected to reflect clear understanding by respondents that such answers are identifying resource-constrained conditions. Although the possibility of respondents' intentional misreporting exists, as in every survey, the history and nature of the CPS, the high degree of preparedness of CPS interviewers, and the careful design and testing of the Food Security Supplement items all tend to reduce this and other types of measurement error. This point is important because identifying the second classification boundary — the transition from food insecurity with no hunger evident into food insecurity with moderate hunger (adult hunger) evident — relies primarily on evidence that reduced food intake consistent with hunger has occurred within the referenced time period among adults in the household, and that this hunger has resulted specifically from the resource-constrained food insecurity of the household.

The task faced by the analysis team of determining the most appropriate severity level of the initial boundary for the severity range of food insecurity with hunger present involved two kinds of judgment, First, it was necessary to decide which specific items available in the scale should be taken to indicate actual hunger for one or more adults in the household attributable to resource constraint. These potentially include measures of reduced quantities of food intake for adult household members (e.g., Q24, Q25), respondents' subjective assessment of intake adequacy (Q32), or direct perception and report of personal hunger (435). Second, given the scale items available, a judgment is required as to how many such items are needed to provide sufficient evidence that household members have experienced actual hunger due to resource constraint. As explained below, the threshold ultimately chosen relies on evidence of a repeated pattern of reductions in food intake by adults over the referenced time period.

The physiological sensation of hunger is experienced universally by all humans, and a large research literature exists examining the nature of the experience in the context of basic

human physiology and clinical nutrition.[8] Several articles from this research literature are summarized in Appendix A of the present volume. The studies described in this literature provide strong support for the validity of subjective reporting of the sensation of hunger (see, for example, Mattes and Friedman, 1993), although they find considerable variation in how the sensation is experienced and described.

These studies seem to provide clear evidence that when usual patterns of eating are interrupted by reducing food intake through actions such as cutting the size of meals or skipping meals, the "uneasy or painful sensation caused by a lack of food" is the natural result. The intensity of the sensations experienced is positively associated with the length of the period of abstinence, although they diminish and may disappear altogether after an extended period of fasting (usually several days). The results reported in this literature are thus consistent with the use of items indicating that reduced food intakes below usual or normal meal patterns, due to resource stringency, are evidence that hunger has been experienced.

Referring to Exhibit 4-3 above, after Q55 the next most severe item to indicate reduction of food intake among adults is item Q24 (Adults cut/skip meals). Note that this item appears in Exhibit 4-3 at virtually the same level as child item Q56 (Child not fed balanced meals), which indicates reduction in the quality of diets provided to children in the household at this level of severity of food insecurity. The next item (Q32, Respondent eat less than should) indicates that food intake has fallen below the respondent's own normative standard for the amount of food he or she should be eating.

An affirmative response to item Q25 indicates that, in addition to all of the foregoing conditions, adults in the household cut the size of or skipped meals in three or more of the previous twelve months due to constrained resources, indicating a pattern of repetition of reduced food intakes among adult household members. This item was judged to provide sufficient additional evidence for the presence of adult hunger in the household, and was chosen, therefore, as the item indicating the point of transition from the category of food insecurity with hunger not evident to the category of food insecurity with adult hunger evident. Households in which the respondent answered affirmatively to item Q25 will, in the modal case, also have

[8] See Mattes and Friedman (1993) and Read, French and Cunningham (1994) for two general reviews covering much of this research (see References, Appendix A).

answered affirmatively to all previous items, indicating the household has experienced a comparatively severe level of food insecurity. The affirmative answer to item Q25 indicates that adults in the household have experienced, in addition, a pattern of repeated reductions in food intakes of a type that the physiological research literature indicates is normally accompanied by the "uneasy or painful sensation caused by a lack of food, " or hunger.

When considering the selection or identification of cutpoint items, and when deciding whether affirmative responses to items or sets of items yielded sufficiently clear evidence of a particular condition (e . g . , resource-constrained adult hunger), the study team employed a general principle of requiring a pattern of repetition of either behaviors or items, or both. Thus, in considering items indicating reduced food intake among adults, Q25 was viewed as providing sufficient evidence because it involved occurrence of the behavior "cutting or skipping meals" in a recurring pattern over the previous twelve months. Similarly, when considering items indicating the existence of food insecurity with no hunger evident, a pattern of affirmative responses to a sequential series of items was considered stronger evidence than affirmation of only one or two pertinent items. This principle was employed to provide additional assurance against response error. [9]

4.5 Evidence of Child Hunger and Severe Adult Hunger

Exhibit 4-3 shows items Q38, Q40, Q28, and Q47 all grouped at nearly the same level of severity and located at a considerably increased level of severity beyond items Q25, Q57, and Q35. The logic described above for selection of item Q25 as the threshold item for food insecurity with adult hunger evident might suggest item Q40 (size of children's meals cut) as a likely candidate for the best item indicating the transition into food insecurity with severe hunger, because children's hunger is conceptually the most salient aspect of severe hunger in the household. For reasons similar to those outlined above, however, a more severe item was chosen. The wording of item Q40 allows the respondent to answer affiatively if children in the household had their meal size cut due to resource constraint only once or a small number of times within the previous twelve months. Here again, sufficient evidence of hunger among

[9] Issues of response error are discussed further in Chapter Eight.

children was thought to require either a repetitive pattern of reduced food intake or a multiple series of responses indicating such a condition.

Note that the child items indicating meals being cut and skipping meals occur as two separate items, unlike the adult version, in which these two conditions are combined as one item. The item addressing children skipping meals appears in Exhibit 4-3 at a much higher level of severity than the item regarding size of children's meals being cut. Skipping meals, as would be expected, reflects a more severe condition than cutting the size of meals. In addition, adult items Q38, Q28, and Q29, all of which indicate comparatively severe levels of adult hunger, appear prior to child item Q44, which indicates a pattern of repeatedly skipped meals among children.

These circumstances led team members initially to choose item Q47 (child hungry but couldn't afford more food) as the cutpoint indicating the beginning of food insecurity with child or severe adult hunger evident. Assignment of household food security status using item Q47 as this cutpoint, however, led to anomalous results due to the different numbers of items presented to households with and without children. This anomaly was avoided by choosing item Q28, which appears at virtually the same severity level as item. Q47 in Exhibit 4-3, as the cutpoint item indicating the transition from food insecurity with adult hunger evident into food insecurity with child and severe adult hunger evident.

In modal. households with children responding affirmatively to item Q28, two items related to reduction of food intake among children receive "yes" answers: item Q57 (children were not eating enough) and item Q40 (children had meal size cut). Moreover, respondents in all household types respond affirmatively to 435, Q38, and Q28, indicating that adults in the households "were hungry but did not eat because they couldn't afford food," "lost weight because there wasn't enough food," and did "not eat for a whole day because there wasn't enough money for food. " Affirmative responses to these items, taken together with affitive responses to all less severe items, appear to provide clear and strong evidence of child hunger and severe adult hunger.

4.6 SUMMARY

The primary task of the food security measurement study was to identify, test, and develop a unidimensional measure of food insecurity and hunger based on the CPS food security data, if a statistically strong and sound measure of this kind could be found. The Rasch measurement method was successful in producing a unidimensional, continuous-variable measure of severity of food insecurity and hunger from the CPS data that met these requirements. The second task of the project, which was dependent upon the success of the underlying continuous measure, was to develop a categorical-variable measure of several designated ranges of severity of food insecurity, and the classification of households into these designated severity ranges or categories, as follows:

- food secure
- food insecure with hunger not evident
- food insecure with moderate hunger
- food insecure with severe hunger

The conceptual construct for these designated ranges of severity was drawn from the AIN/LSRO conceptual definitions of food insecurity and hunger, from other prior research on food security measurement, and from limiting the measurement effort to one of the central elements of the broad food security concept that is amenable to direct measurement, the direct household experience of insufficient food to meet basic needs. Other elements of the broad conceptual definition, such as safety of food, actual nutritional adequacy of diets, and social acceptability of food acquisition, are not encompassed in the present measure of severity of food insecurity.

The categorical measure of food security status depends on classifying households into identifiable ranges of severity on the underlying continuous severity measure. The aim in identifying or selecting the appropriate ranges of severity on the continuous measure was to achieve acceptably close correspondence to the conceptual bases of the designated broad food security status categories described above. The operational means of establishing the several severity ranges was to select the most appropriate indicator items from among those available in the continuous measurement scale to identify, or defme operationally, the classification boundaries, or thresholds, separating each designated severity range category from the next.

This task involved judgment as to which items best reflect the transition from one broad range or category of severity to the next.

Identification of the threshold items and their associated scale **cutpoint** scores for each level of the categorical food security status variable involved use of statistical results from the **Rasch** model, guided by the **LSRO/AIN** conceptual definitions of hunger and the results of previous research in the areas of physiology, clinical nutrition, and food security measurement. Team members combined these factors to select thresholds or **cutpoint** items that are most consistent with the statistical results, empirical evidence, and the conceptual framework representing the predominant understanding of food insecurity and hunger within the nutrition science community.

CHAPTER FIVE
THE RESOURCE AUGMENTATION QUESTIONS

In fitting the model for the 12-month food security scale, one group of questions was conspicuously not included because they did not meet the statistical criteria for inclusion in the scale. These questions involve actions that households might take to deal with a problem of constrained food resources, and specifically actions other than reducing food intake or otherwise modifying the internal household management of food resources. The questions refer to actions such as putting off other bills in order to buy food, or obtaining meals from soup kitchens. The class of actions has variously been termed "coping" or "resource augmentation" behaviors.

Because resource augmentation behaviors are pertinent to one dimension of the LSRO/AIN definition of food insecurity — the ability to acquire food in "socially acceptable ways" — the research team considered it important to explore the possibility of supplementing the primary food security scale with some composite based on the resource augmentation questions. For example, the food security status variable, rather than simply being based on a subdivision of the primary scale, might also take into account the household's value on the resource augmentation composite. Ultimately it was concluded that, although such a composite might be useful for some researchers in particular situations, it does not add significant value to the food security status variable.

This chapter reviews both the conceptual underpinnings of the effort to construct a composite, the procedures that were implemented, and the likely effect of using a composite such as that described.

5.1 TWO DIMENSIONS OF FOOD INSECURITY

The LSRO/AIN conceptual definition of food insecurity includes several diverse aspects or dimensions of households' food situations, of which only one central element — the direct experience of insufficient food to meet basic needs — is captured in the measure developed from the CPS food security data.

Households can, however, be food insecure either because they are unable to obtain enough food (for discussion, call this food insecurity "type A"), or because they have to resort

to socially unacceptable ways of obtaining food (call this "type B"). They may also be food insecure for both these reasons. That is, they may resort to socially unacceptable ways of obtaining food and still not obtain access to sufficient food (call this "type A&B").

Because resource-constrained hunger is understood to be nested within food insecurity, it will not occur in a household unless that household is food insecure. If a household is food insecure type A (unable to obtain enough food) at a sufficient level of severity, then hunger may result. Likewise, if a household is food insecure type A&B, hunger may still emerge, despite the household's efforts to augment its available food through various coping measures. If a household's food insecurity is limited to type B only, however, the presence of basic food insufficiency and hunger within the household **cannot** be inferred from this information. This relationship is illustrated in Exhibit 5-1.

Exhibit 5-1

ILLUSTRATION OF ROLE OF RESOURCE AUGMENTATION BEHAVIORS

Food Availability		Mode of Acquisition	Food Security Status
Sufficient food available	**AND**	Socially acceptable acquisition ☞	Food secure
Limited or uncertain availability (anxiety, adjustments to budget management, adjustments to food quality)	**OR**	Resource augmentation via socially unacceptable means ☞	Food insecure with hunger not evident
Severely limited availability (reduced food intake and other indicators)		. . . . . ☞	Food insecure with evidence of hunger

The availability of sufficient foods to meet basic needs (food insecurity type A). *This* dimension is well represented in the final unidimensional 12-month scale. As described in the previous chapter, scale development activities demonstrated that it is possible to **define** a range of values on this scale that can be used to classify households as "food insecure" on the basis

of limited availability of foods relative to household need, operationally indicated by a pattern of anxiety about the adequacy of the household's food supply, and deterioration in the quality and quantity of food available in the household.

The ability to acquire foods in socially acceptable ways, or via normal channels (food insecurity type B). ***The*** scale development models employed do not capture this dimension. Using the final 12-month scale to classify households as food insecure leaves open the possibility that some households relying on extraordinary coping methods to acquire food in socially unacceptable ways will be classified as food secure.

This situation emerges because the items in the CPS Food Security data that address this latter dimension of food insecurity do not fit the measurement models leading to the final 12-month scale. Two sets of items ask questions that provide indications of whether households obtained food in ways that might be considered socially unacceptable. One set of items asks whether households undertook actions to augment their food supply or other household resources within the previous 12 months. These items are summarized in Exhibit 5-2.

Exhibit 5-2

RESOURCE AUGMENTATION ITEMS IN THE FOOD SECURITY SURVEY INSTRUMENT

Item Label	Item Summary/Description
Q18	"get food or borrow money for food from family or friends?"
Q19	"send or take children to the homes of friends or relatives for a meal?"
Q21	"put off paying a bill so you would have money to buy food?"
Q22	"get emergency food from a church, food pantry, or food bank?"
023	"eat meals at a soup kitchen?"

A second set of items asks whether members of the household obtained food through federal food assistance programs. These programs include food stamps, elderly feeding programs, the child and adult care feeding program, school feeding programs, and WIC. There are two strong arguments, however, for not using these items to classify households as food insecure.

First, participation in such programs may not be considered "socially unacceptable" by many of the participants. There is some evidence to that effect, although this point has not been adequately researched (Trippe and Beebout, 1988; Fraker, 1990; Radimer, Olson and Campbell, 1990; Trippe, Doyle and Asher, 1992; Olson, Frongillo and Kendall, 1995).

Second, there is a problem of logical circularity that could diminish the usefulness of the food insecurity measures for policy considerations. The food insecurity measures are potentially useful in helping policy makers assess the need for government food assistance programs. Including program participation in the food insecurity measures, however, permits the following potentially perverse result: If the government makes programs more available (for example, by increasing the income eligibility threshold for free school lunches, or food stamps), more people will participate and the experienced level of food insecurity would be expected to decline. The measured level, however, may either decline or increase, depending on how the participation indicator interacts with other indicators of the condition. Conversely, if the government cuts back on programs, participation will decline and the effect of the participation indicator may cause the measured level of food insecurity to go down (i.e., the food insecurity problem can be "solved" by taking away the programs). Because of this situation, participation in government food assistance programs was not included in the candidate pool of items for a resource-augmentation index.

For the classification of households as food insecure to be more fully consistent with the LSRO/AIN definitions, there would need to be a way to include information on food acquisition through ways that are not socially acceptable (non-normal channels). An important part of the indicator items used in earlier efforts to develop measures of food insecurity and hunger reflect actions or behaviors undertaken by household food managers to avoid or ameliorate hunger when food or financial resources become scarce. Sometimes referred to as "coping behaviors" or "coping strategies, " these behaviors include actions aimed at augmenting the amount of food available to the household, or its financial resources for food, and they can include actions to acquire food in ways that may be considered socially unacceptable, such as those actions shown in Exhibit 5-2.

5.2 THE COMPOSITE RESOURCE AUGMENTATION INDEX

The feasibility of creating a separate resource augmentation scale was first examined by fitting the five items in Exhibit 5-2, along with others, in Rasch models. Reliability estimates for the resulting scales were below acceptable levels, however. This was due partially to the small number of items available for inclusion in the models. Efforts to increase scale reliability by adding items to the model were not successful.

One possible reason for the lack of fit has to do with the widely uneven opportunity for the resource augmentation actions, or coping behavior, across households. For example, in order to obtain food from a church, food pantry, or food bank, households must have access to these facilities. That is, they must live in an area where such services are provided, and be able to get to them. Similarly, with borrowing money or food from family or friends, such social-support relationships must be available to the household before they can employ this coping strategy. With the possible exception of item Q21 ("put off paying a bill so that you would have money to buy food"), none of the resource augmentation items listed in Exhibit 5-2 are necessarily available to all households who might use them if the opportunity were present.

Because the attempt to construct a Rasch scale was not successful, the research team considered instead the creation of a simple composite or index based on the number of resource augmentation questions a household answered affirmatively. The index is derived using the five resource augmentation items in Exhibit 5-2. The proportions of each type of household answering affirmatively to the resource augmentation items, weighted to represent the true population proportions, are shown in Exhibit 5-3.

The items with the largest proportions of affirmative responses are Q18 (get food or borrow money from friends or relatives) and Q21 (put off paying bills to have more money to buy food), items which could be interpreted by some respondents as not indicating behaviors that are socially unacceptable. The research team therefore felt that, if the index were to be used in classifying households as food insecure, such classification should be based on a pattern of at least three affirmative responses. This conforms with the general principle of redundancy (either in items or behaviors), employed in Chapter Four in making decisions about items yielding evidence of food insecurity or hunger.

This principle requires clear evidence of a pattern of repetition of an action (e.g., involuntary reduction of food intake in the case of food insecurity with moderate hunger), or a

Exhibit 5-3

POPULATION WEIGHTED PROPORTIONS OF AFFIRMATIVE RESPONSES TO THE RESOURCE AUGMENTATION QUESTIONS BY HOUSEHOLD TYPE

Item Label	Item Description	Households with Children	Households with Elderly but No Children	Households without children or Elderly	All Households
Q21	Put off paying bills to have money to buy food	20.8%	4.5%	9.9%	12.5%
Q18	Get food or borrow money from friends or relatives	12.6%	3.1%	8.1%	8.4%
Q22	Get emergency food from church, food pantry or food bank	4.7%	1.6%	2.1%	3.0%
Q19	Send or take children to friends or relatives for a meal	3.3%	N/A	N/A	1.3%
423	Eat meals at a soup kitchen	0.4%	0.2%	0.7%	0.5%

pattern of repetition of affirmative responses to different items indicating an action or state (e.g., ***three*** out of five resource augmentation items). Although application of this principle requires an exercise of judgment by the study team, it provides an element of assurance against error that might otherwise arise.

5.3 EFFECTS OF USING THE COMPOSITE RESOURCE AUGMENTATION INDEX

A resource augmentation index as described above, and estimates of "type B" food insecurity derived from the index, provide a potential means of broadening the basic categorical measure of food insecurity prevalence to include the dimension of food insecurity involving reliance on non-normal, "emergency, " or "socially unacceptable" forms of food acquisition. The practical effect of broadening the reach of the categorical food security measure in this way, however, turns out to be slight. This is because a very large proportion of the households that would be classified as food insecure on the basis of the resource augmentation index are already classified as food insecure by the underlying measurement scale and the classification criteria for the food security status indicator. The number of ***additional*** households that would be classified as food insecure ***solely*** on the basis of "type B" food insecurity, as measured by the resource augmentation index, is quite small.

The resource augmentation index would be used only to classify households as food insecure with no hunger evident, because it only addresses food insecurity type B (described above). By the logic outlined earlier, type B food insecurity alone cannot be taken as evidence of the presence of hunger, and therefore cannot be used to classify a household as food insecure with hunger evident.

Approximately 0.3 percent (rounded) of all households in the (weighted) sample would be classified as Food Secure on the basis of the scale-based measure, but would be classified as Food Insecure with Hunger not Evident on the basis of the resource augmentation composite. This would raise the proportion classified as Food Insecure with Hunger not Evident from *7.8* percent to 8.0 percent of the population, as shown in Exhibit 5-4. In terms of population weighted values, just under one quarter million additional households would be classified as Food Insecure with Hunger not Evident if the resource augmentation index were used in this way.

Exhibit 5-4

EFFECTS OF THE COMPOSITE RESOURCE AUGMENTATION INDEX ON THE NUMBER AND PERCENT OF HOUSEHOLDS CLASSIFIED AS FOOD SECURE AND FOOD INSECURE WITH NO HUNGER EVIDENT

Measure	Food Secure Households		Food Insecure Households with Hunger not Evident	
Twelve-month scale	Number (thousands)	Percent	Number (thousands)	Percent
Without the resource augmentation index	88,270	88.1	7,783	7.8
With the resource augmentation index	88,020	87.8	8,029	8.0

5.4 SUMMARY

Food insecurity can occur as a result of households experiencing either, or both, of two dimensions included in the LSRO/AIN conceptual definition of food insecurity. The measurement scale developed in the study addresses one of these dimensions (limited or uncertain availability of enough food to meet basic needs), but does not capture the second (limited or uncertain ability to acquire acceptable foods in socially acceptable ways).

In principle, the resource augmentation questions in the CPS Food Security Supplement might be used to create a composite measure that could take this second dimension into account. The research team concluded, however, that it would not be advisable at this time to incorporate such a measure into the definition of households' food security status. This conclusion was based on two considerations.

First, it is not clear that the existing items in the CPS Supplement constitute a sufficiently strong representation of the construct of food acquisition in ways that are not socially acceptable. The fact that the items did not meet the criteria for construction into a scale suggests that they do not make up a coherent and complete picture of the dimension of concern. Incorporating the resource augmentation index into the food security status indicator could therefore create a source of variability in the status indicator that might reduce the validity of comparisons across groups or over time.

Second, incorporating the resource augmentation index into the food security status indicator would make only a small difference in prevalence estimates, a difference that could be considered within the "noise level" of the estimates. If the effect were large — if it suggested that a very large number of food insecure households were being ignored by omission of the resource augmentation index — it might be worth accepting the consequences of potentially increased variability in the prevalence estimates. With only a small effect, however, the costs of including the index appear to outweigh its benefits.

Resource augmentation or coping behaviors therefore constitute an important area for future research. Better understanding is needed of the array of such behaviors that actually exists, the conditions in which they are taken, and their relationship to the dimension of food security captured in the primary food security scale. With improved understanding, it should be possible to refine and improve the current approach to measuring food security.

CHAPTER SIX

EXTERNAL CONSTRUCT VALIDATION OF THE FOOD SECURITY MEASURES

External construct validation is the process of formally examining the relationships of a scale or construct to other similar or related 'measures of the construct that were not used in developing the scale being tested. In the present context, this involves comparing estimates of the households' food security scale scores and food security status to other household measures that are believed to be related to food security and that were not used in construction of the food security measures.

There is no definitive measure of food security — no "gold standard" against which these food security measures can be tested. Absent such a gold standard, the best approach is to examine the relationships between the food security measures and other measures that are understood to have a bearing on food security, provided that one can define an unambiguous hypothesis about the bivariate relationship between the validation measure and the food security measures. Following these criteria, the analysis compares the food security measures to household food expenditures, income, income relative to the poverty line, and the household respondents' report of the sufficiency of food eaten in the household.

For the food security scale, a continuous variable, we calculate the coefficient of correlation between the validation items and the households' measure on the food security scale. For the categorical measure of food security status, we examine the percent of households at each level of severity of food 'insecurity within groups defined by the validation items. Because the food security scales were developed using unweighted data, the construct validation results reported here are also unweighted.

6.1 RELATIONSHIP OF CONSTRUCT VALIDATION ITEMS TO FOOD SECURITY

The LSRO expert panel identified four dimensions of food security that need to be addressed at the household and individual level when measuring food security. Those four dimensions are: the quantity of food intake, the quality of food intake, anxiety about the adequacy of food supply, and social acceptability of the source of food (Anderson/LSRO, 1990).

The CPS Food Security Supplement included questions intended to capture each of these four dimensions, and all dimensions are included in some form in the food security measures developed for this study. [1] The discussion below considers each of the four chosen construct validation items, focusing on the theoretically expected relationship between the construct validation item and food sufficiency, the limitations of the validation item as a measure of food security, and the results of the construct validation effort.

6.2 WEEKLY FOOD EXPENDITURES PER HOUSEHOLD MEMBER

The predominant way for households to acquire food is to purchase it through normal commercial channels with the financial resources available to the household. One would therefore expect to see a relationship between the level of food expenditures and the quantity and quality of food intake, two dimensions of food security. Hence, one item we chose for comparison with the food security measures is food expenditures: specifically, weekly food expenditures per household member.[2] The hypothesis is that weekly food expenditures per household member will be negatively correlated with the level of food insecurity.

The obvious connection between food expenditures and food insecurity might not be as strong as it first appears because there are several conceptual weaknesses of weekly food expenditures as a measure of food sufficiency and some limitations in using the available expenditure data for validation purposes. Conceptually, food expenditures are not an ideal measure of food sufficiency because expenditures do not include food from most in-kind programs (although food stamp purchases are included) or home-grown food, do not reflect differences in costs for food across localities, and even in per-capita form do not perfectly adjust for the specific food needs of a household. Moreover, households that have, on average, sufficient weekly food expenditures may still experience weeks where they do not have financial

[1] Both the 12-month and 30-day scales include items related to the quantity of food intake (e.g., cutting or skipping meals) and a smaller number of items related to quality (e.g., not being able to serve balanced meals). Anxiety is explicitly represented only in the 12-month scale (e.g., being worried that food would run out before more money was available). Social acceptability is not explicitly addressed by any of the items in the continuous scales, but is measured by the resource augmentation items used in constructing the categorical food status variable for the 12-month period.

[2] Respondents were asked a battery of questions regarding food expenditures in the past week as well as "usual" food expenditures. Respondents were instructed to include purchases made with food stamps in their report of expenditures on food.

resources to purchase sufficient amounts of food. One data limitation of the measure is that the food expenditure questions on the survey ask aboutusual weekly and monthly spending patterns on food, but do not give a specific time period for which usual weekly or monthly spending is reported, and hence may not match the time period over which food security is measured. Also, food expenditures for the entire household are reported by one respondent, but this respondent may not have accurate information on the food expenditures of other household members. Finally, much of the variation in per capita food expenditures, especially at higher expenditure levels, presumably reflects variations in convenience or luxury that would not be relevant to or captured by the food security measures, because the food security measures give all food secure households the same score.

Exhibit 6-l shows that the correlation coefficients between the food security scales and weekly food expenditures per household are negative, as expected. The values of the coefficients, however, are quite small: −.12 for the 12-month scale and −.07 for the 30-day scale. The cross tabulation of food expenditures with the categorical food security status variable reported in Exhibit 6-2 also shows the expected pattern: the lower the level of food expenditures, the more likely the household is to be in each of the food insecure categories. For the 12-month scale, 1.4 percent of households that report weekly food expenditures less than $20 per person are in the most severe category of food insecurity, whereas only 0.5 percent of households reporting expenditures of more than $40 per person are in this category. More generally, about 21 percent of the low food spending households are in one of the three food insecure categories, whereas only 6.5 percent of the high food spending households are in one of the food insecure categories.

The same pattern is evident for the 30-day scale, although the overall percentage of households classified as food insecure is much smaller than in the 12-month scale. For example, 4.4 percent of the households reporting they spend less than $20 per household member are classified as showing evidence of hunger in the household, whereas a much smaller 1.2 percent of the households reporting spending $40 or more per household member show evidence of hunger.

Exhibit 6-1

CORRELATION COEFFICIENTS FOR FOOD SECURITY SCALE SCORES **AND** OTHER **VARIABLES** RELATED TO FOOD SECURITY

	Food security Measure	Weekly food Expenditures per Household Member	Annual Household Income	Income Relative to the Poverty Line
12-Month Variable				
Food security measure	1.00	−.12	−.32	−.33
Weekly food expenditures per household member	-.12	1.00	.23	.36
Annual household income	−.32	.23	1.00	.89
Income relative to the poverty line	−.33	.36	.89	1.00
30-Day Variable				
Food security measure	1.00	−.07	−.16	−.16
Weekly food expenditures per household member	-.07	1.00	.23	.36
Annual household income	−.16	.23	1.00	.89
Income relative to the poverty line	−.16	.36	.89	1.00

6.3 HOUSEHOLD INCOME

The financial resources of a household are a primary determinant of the level of household food expenditures. This means that the financial resources of a household should be related to the quantity and quality of food intake. Moreover, households' anxieties about the adequacy of their food resources and their likelihood of resorting to non-normal modes of food acquisition are presumed to increase as their financial resources diminish. Hence, household income is related to all four dimensions of food insecurity mentioned earlier. Household income is expected to be negatively correlated with the level of food insecurity. Here, it is measured both as total annual income and as income relative to the federal poverty line for the given household composition.

Despite the logical connection between household income and food insecurity, one would not expect the correlation to be perfect for several reasons. In particular, **food assistance** programs, which are designed to ameliorate food insecurity, are specifically targeted to

households with low income, which reduces the relationship between food insecurity and income. Additional reasons one would not expect income to be perfectly correlated with food insecurity are that household income does not include all the assets of a household (e.g., savings), is not adjusted for the food and nutritional needs of a household, and does not reflect the competing demands for financial resources within a household. Also, total income for a year may be substantial even though the year includes periods of time where financial resources are tight, such as a period when the primary earner is unemployed. Finally, much of the variation in income occurs at higher income levels where there is little or no corresponding variation in the food security measures.

The income measure on the April 1995 data file also has several shortcomings that make it an imperfect measure of household income. Chief among them are: income is a categorical variable, analytically converted to a pseudo-continuous variable by taking the midpoints of the categories; household income is derived from a question that asks about family rather than household income, although in most cases these units are the same; and the 12-month period over which income is measured does not exactly match the time period for which food security is measured for most of the sample households.[3] A further potential limitation is that the income measured is cash income, and does not capture the value of food stamp benefits or other in-kind food assistance. One might expect that food security would be more closely related to a measure of income incorporating such transfers than to the cash income measure.

As expected, Exhibit 6-l shows that food insecurity is clearly negatively related to both annual household income and poverty-scaled income. Annual household income and the 12-month food security scale have a correlation coefficient of −.32, whereas income and the 30-day food security scale have a smaller correlation coefficient of −.16. The correlations with poverty-scaled income are almost identical. All of these correlations are stronger than the correlation of the food security scales with food expenditures.

[3] Each CPS sample is divided into eight approximately equal rotation groups, with each group interviewed four consecutive months, dropped out for eight consecutive months, then brought back in for four more consecutive months before being retired. The household income measure is usually from the first month of each four consecutive month spell in the CPS survey. Thus, although food security is measured for the 12 months preceding the April 1995 survey, income is measured for the 12 months preceding: January 1995 for rotation groups four and eight; February 1995 for rotation groups three and seven; March 1995 for rotation groups two and six; and April 1995 for rotation groups one and five.

Exhibit 6-2

RELATIONSHIP OF THE FOOD SECURITY STATUS VARIABLE TO OTHER VARIABLES

	Food Secure	Food Insecure, Hunger not Evident	Food Insecure, Moderate Hunger Evident[a]	Food Insecure, Severe Hunger Evident[b]
12-Month Variable				
Weekly food expenditures per household member				
< $20	79.2%	13.9%	5.6%	1.4%
$20-29	88.0	8.6	2.9	0.6
$30-39	92.4	5.3	2.0	0.3
$40 or more	93.7	4.0	1.9	0.5
Income relative to poverty line				
< 50%	59.5	24.2	11.4	4.9
50-100%	69.6	20.1	8.2	1.9
101-185%	82.6	11.9	4.6	0.9
> 185%	96.2	2.6	1.0	0.2
Food sufficiency variable (from one-part version of question)				
Often not enough to eat	15.8	29.0	18.4	36.8
Sometimes not enough to eat	21.8	31.5	36.3	10.5
Enough but not always the kinds of food we want do eat	63.6	25.9	9.4	1.0
Enough of the kinds of food we want to eat	95.9	3.4	0.6	0.1
Food sufficiency variable (from two-part version of question)				
Often not enough to eat	14.4	23.2	33.4	29.0
Sometimes not enough to eat	24.0	38.0	31.3	6.6
Enough but not always the kinds of food we want do eat	**67.1**	**25.7**	**6.3**	**0.9**
Enough of the hinds of food we want to eat	96.7	2.7	0.5	0.1

[a] See notes at end of exhibit.

Exhibit **6-2** ***(continued)***

RELATIONSHIP **OF THE** FOOD SECURITY STATUS VARIABLE TO **OTHER** VARIABLES

	No Hunger Evident	Food Insecure, Moderate Hunger Evident[a]	Food Insecure, Severe Hunger Evident[b]
30-Day Variable			
Weekly food expenditures per household member			
< $20	95.6%	3.6%	0.8%
$20-29	98.0	1.7	0.3
$30-39	98.7	1.1	0.2
$40 or more	98.8	1.0	0.2
Income relative to poverty line			
< 50%	90.1	7.3	2.6
50-100%	94.4	4.3	1.3
101-185%	96.7	2.8	0.4
> 185%	99.3	0.6	0.1
Food sufficiency variable (from one-part version of question)			
Often not enough to eat	52.6	18.4	29.0
Sometimes not enough to eat	65.3	28.2	6.5
Enough but not always the kinds of food we want to eat	94.4	5.0	0.6
Enough of the hinds of food we want to eat	99.7	0.3	0.0
Food sufficiency variable (from two-part version of question)			
Often not enough to eat	48.4	30.5	21.1
Sometimes not enough to eat	76.3	19.9	3.8
Enough but not always the kinds of food we want to eat	96.6	3.2	0.3
Enough of the hinds of food we want to eat	99.8	0.2	0.0

[a] Limited to adult hunger at identifiable but moderate levels of severity.

[b] Evidence of children's hunger and severe adult hunger.

Exhibit 6-2 shows that among households whose income is less than half of the federal poverty level, more than 40 percent are classified as having experienced some kind of food **insecurity in the past** 12 months, and 5 percent fall into the most severe category of food insecurity. In contrast, only 4 percent of the households with annual income above 185 percent of the poverty level are classified as food insecure, and only 0.2 percent are in the most severe category of food insecurity. The patterns for the 30-day food security scale are similar: 10 percent of households with income below 50 percent of the poverty level have experienced hunger in the past 30 days, whereas less than 1 percent of households with income more than 185 percent of the poverty level have such experiences.

6.4 FOOD SUFFICIENCY

The final construct validation item is a single-item household food sufficiency measure that has been used in previous research, appearing in a substantial number of national food use and other types of surveys. Specifically, the respondent was asked which best describes the food eaten in their household: enough of the kinds of food we want to eat; enough, but not always the kinds of food we want to eat; sometimes not enough to eat; or often not enough to eat. This measure focuses directly on two of the four dimensions of food insecurity: the quantity and quality of food intake. Hence, we expect households that report a more severe food insufficiency experience to be classified in a more severe food insecurity category.

The single-item food sufficiency measure does not have a clearly defmed time reference, simply asking respondents to characterize the "food eaten in your household." It does not explicitly address two of the dimensions of food insecurity (anxiety and socially unacceptable modes of food acquisition). It has four categories, which could permit a category-by-category comparison with the four-category 12-month measure of food insecurity, but the conceptual underpinnings of the two categorization schemes are not identical.[4] A technical complication with the food insufficiency measure is that it has been applied in the CPS Supplement in two

[4] For example, a respondent answering "not always the kinds of food we want" can be expressing food preferences unrelated to food insufficiency due to inadequate resources. At the more severe levels, the food sufficiency measure distinguishes households on the basis of the frequency with which the situation occurs ("sometimes" vs. "often" not enough to eat). The primary basis for distinguishing between the two most severe categories of the food security variable, on the other hand, is whether the experience of hunger is limited to adults in the household vs. adults and children both experiencing hunger.

formats: a one-question version and a two-question version.[5] Each version was applied to a different portion of the CPS sample. Both versions were compared to the categorical food security status variables, and the results are reported in Exhibit 6-2.

Both versions of the food sufficiency measure have the expected strong positive relationship with food security status: households that report more severe food insufficiency experiences tend to be classified in a more severe food insecurity category. For the one-part version of the food sufficiency measure, 84 percent of households reporting "often not enough to eat" are classified as food insecure by the 12-month scale, including 37 percent in the most severe category of food insecurity. In contrast, only 4 percent of households reporting "enough of the kinds of food we want to eat" are in any of the food insecure categories, including only 0.1 percent in the most severe category of food insecurity.

The 30-day food security scale shows a similarly strong relationship with the one-part and two-part versions of the food sufficiency question, although the overall prevalence of food insecurity is smaller for the 30-day scale. Very few of the households reporting "enough of the kinds of food we want to eat" are classified in either of the categories evidencing hunger: only 0.2 to 0.3 percent. In contrast, around half of the households reporting "often not enough to eat" are classified as food insecure with evidence of hunger.

6.5 SUMMARY

The results of these analyses are consistent with the view that the food security measures presented in this study constitute valid measures of the underlying constructs of food insecurity and hunger. This provides as much assurance as one can expect at this stage that the measures provide the desired information. By their nature, however, the tests conducted here cannot be conclusive. All of the items used as points of comparison were designed to measure something other than food security. A perfect measure of food security would therefore not be exactly correlated with any of them, but there is no basis for knowing exactly how close the correlation should be. Further validation will be desirable, including additional comparisons of the food security variables to potentially related measures. In particular, the relationship of the

[5] See question 1 la for the single-question version of the food sufficiency item, and questions 11 and 12 for the two-question version in the CPS Food Security Supplement instrument.

present measure of the central dimension of food insecurity and hunger as experienced in U.S. households and established measures of the nutritional quality of diets and their health consequences will be an important area of further research.

CHAPTER SEVEN

PROCEDURES FOR CALCULATING STANDARD ERRORS FOR FOOD SECURITY PREVALENCE ESTIMATES

The *Summary* Report presents standard errors for our food security prevalence estimates as an indicator of the degree of uncertainty surrounding reported point estimates due to relying on a sample from the population rather than an entire census of the population.[1] The conventional procedures for estimating the standard errors of estimates, as incorporated in most statistical software packages, are appropriate only for simple random samples from the population. For efficiency reasons, the Current Population Survey (CPS) relies on a complex sampling design that does not result in a simple random sample of households in the U.S. population. Accordingly, it is necessary in the food security analysis to estimate variances by other means. This chapter briefly explains the CPS sampling design and the method used for calculating standard errors of estimates of the prevalence of food insecurity from April 1995 CPS data.

7.1 CPS SAMPLE DESIGN

The sampling design used by the CPS is essentially a two-stage sampling procedure. In the first stage, CPS stratifies groups of counties (Primary Sampling Units, or PSUs) and Metropolitan Statistical Areas (MSAs) according to geographic location, and basic labor force and demographic characteristics of the geographic area (from the most recent decennial census). One PSU from each stratum is selected to represent the stratum in the sample. Because only households in the selected PSUs are eligible to be in the sample, the usual variance estimation formulas developed under the assumption of simple random sampling will underestimate the between-PSU portion of variance to the extent that the chosen PSUs do not capture the variability among all PSUs.

In the second stage of sampling, clusters of households within PSUs are selected to be in the sample. In this case, the usual variance estimation formulas will underestimate the within-PSU portion of variance to the extent that there is homogeneity within households in a cluster.

[1] See Appendix E of the *Summary Report* (Hamilton *et al.*, 1997).

Variance estimates provided by all-purpose statistical packages, such as SAS, assume simple random sampling from the population of interest and equal weighting of each household; hence, they are not appropriate for use with the complex CPS sampling procedure. Below, we describe the variance estimation procedure used for taking into account the between-PSU variance (sampling of MSAs and county groups) and within-PSU variance (sampling of households within PSUs). This procedure was developed in consultation with statisticians from the Census Bureau's CPS Division.

7.2 Adjustment Factor for Between-PSU Variance

We are unable to estimate between-PSU variance directly because information on a household's PSU is withheld from the data files to protect confidentiality of respondents. Instead, we have calculated an adjustment factor to reflect 'this stage of sampling in our variance estimates.

To estimate the between-PSU variance indirectly, we referred to unpublished components of variance for several available CPS labor force estimates from November 1995, and components of variance for a more extensive set of labor force estimates reported in Train and Cahoon (1978).[2] Because we are primarily interested in household estimates, we considered those characteristics from the Train and Cahoon paper that are usually based on one person per household.[3] The between-PSU variance as a proportion of total variance was about 5 percent for two of the characteristics, and about 9 percent for the third characteristic. The between-PSU variance tended to comprise a somewhat smaller proportion of total variance in the November 1995 CPS estimates than in the 1978 study.[4] Averaging these proportions, we estimated that the between-PSU variance for April supplement estimates is about 6 percent of

[2] Train, G. and L. Cahoon, "The Current Population Survey Variances, Inter-Relationships, and Design Effects," ***Proceedings of the Section on Survey Research Methods of the American Statistical*** *Association*, 1978, p. 443-448.

[3] These characteristics are the number of self-employed in each household, teenage labor force participation, and teenage unemployment.

[4] The only characteristics available from November 1995 are the total number of employed persons, unemployed persons, and labor force participants. The between-PSU variance for these characteristics were compared to the Train and Cahoon (1978) estimates for the same characteristics.

total variance. This translates into applying a factor of 1.06 to our direct estimates of the within-PSU variance to obtain estimates of total variance.

7.3 ESTIMATION OF WITHIN-PSU VARIANCE

We used the "random groups" method to estimate the within-PSU component of variance.[5] This procedure measures the sensitivity of an estimate to the particular sample drawn from within selected PSUs. That is, the within-PSU component of variance is calculated by finding the variance of estimates obtained with different samples drawn from the same PSUs.

The eight CPS rotation groups provide an ideal mechanism for dividing the CPS sample to estimate the variance among different samples taken from the same PSUs.[6] Each rotation group is an independent sample of households from all the sample PSUs. Thus, we can divide the CPS sample into half-samples with four rotation groups in each. Each rotation group also independently has the full CPS ratio estimation procedure applied, in which the sample weights are adjusted to independent estimates of the civilian non-institutional population of the U.S. Thus, use of rotation groups allows us to reflect the reduction in variance due to application of the ratio estimation procedure to population controls used in the CPS.[7] Exhibit 7-l shows the allocation of the eight rotation groups for each of the 30 definitions of half-samples used for our calculations.

To estimate the within-PSU component of the variance for an estimate of the total number of households in food security category *i (e.g., the* total number of households in the U.S. that are *food insecure with moderate (adult) hunger evident), we* used the random groups variance formula (see Hansen, Hurwitz, and Madow, 1953, p. 440), adjusted for half-samples

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[5] For a more detailed description of this method, see Hansen, Hurwitz and Madow, 1953.

[6] Each month a new rotation group is added to the CPS sample and an old rotation group is dropped from the sample. Sample households in a rotation group are surveyed for four consecutive months, then take eight months off, before being surveyed for four more consecutive months and then dropped from the sample; e.g., a household that enters the survey in January 1995 will be interviewed in January, February, March and April 1995, and again in the same months in 1996.

[7] The SUDAAN program is often used to estimate variances in weighted samples. To use the estimation procedure in the SUDAAN variance program, however, it is necessary to know the weights before application of the ratio estimation procedure, as well as the final weights. Because these pre-ratio estimation weights are not available, the SUDAAN program is not applicable in the present instance.

Exhibit 7-l

ROTATION GROUPS IN EACH DEFINITION OF HALF-SAMPLE

Definition of Half-Samples	CPS Rotation Groups in Half-Sample 1	CPS Rotation Groups in Half-Sample 2
1	6, 1, 2, 3	4, 5, 7, 8
2	6, 1, 2, 4	3, 5, 7, 8
3	6, 1, 2, 5	3, 4, 7, 8
4	6, 1, 3, 4	2, 5, 7, 8
5	6, 1, 3, 5	2, 4, 7, 8
6	6, 1, 4, 5	2, 3, 7, 8
7	6, 2, 3, 4	1, 5, 7, 8
8	6, 2, 3, 5	1, 4, 7, 8
9	6, 2, 4, 5	1, 3, 7, 8
10	6, 3, 4, 5	1, 2, 7, 8
11	7, 1, 2, 3	4, 5, 6, 8
12	7, 1, 2, 4	3, 5, 6, 8
13	7, 1, 2, 5	3, 4, 6, 8
14	7, 1, 3, 4	2, 5, 6, 8
15	7, 1, 3, 5	2, 4, 6, 8
16	7, 1, 4, 5	2, 3, 6, 8
17	7, 2, 3, 4	1, 5, 6, 8
18	7, 2, 3, 5	1, 4, 6, 8
19	7, 2, 4, 5	1, 3, 6, 8
20	7, 3, 4, 5	1, 2, 6, 8
21	8, 1, 2, 3	4, 5, 6, 7
22	8, 1, 2, 4	3, 5, 6, 7
23	8, 1, 2, 5	3, 4, 6, 7
24	8, 1, 3, 4	2, 5, 6, 7
25	8, 1, 3, 5	2, 4, 6, 7
26	8, 1, 4, 5	2, 3, 6, 7
27	8, 2, 3, 4	1, 5, 6, 7
28	8, 2, 3, 5	1, 4, 6, 7
29	8, 2, 4, 5	1, 3, 6, 7
30	8, 3, 4, 5	1, 2, 6, 7

that are not exactly the same size (see **Cochran,** 1977, p.139). The variance formula for totals is listed below:

$$2 * \left[\left(X_{i1} - \frac{N_1 * X_i}{N} \right)^2 + \left(X_{i2} - \frac{N_2 * X_i}{N} \right)^2 \right] \quad (1)$$

where

X_{i1} is the weighted number of households in the first half-sample that are in food security category *i;*

X_{i2} is the weighted number of households in the second half-sample that are in food security category *i;*

X_i is the weighted number of households in the full sample that are in food security category *i.*

N_1 is the weighted number of households in the first half-sample;

N_2 is the weighted number of households in the second half-sample; and

N is the weighted number of households in the full sample.

This yields the estimated within-PSU variance for estimated totals from a single definition of half-samples. We form 30 definitions of half-samples from the eight rotation groups, resulting in 30 estimates of variance. The fmal within-PSU variance estimate is an average of these 30 estimates. [8]

For estimated proportions, such as the proportion of all households experiencing food insecurity with moderate hunger evident, we use the variance formula for ratios in **Cochran** (1977, p. 155). *The* variance of the proportion, X_i/Y, where X_i is the estimated number of households in food security category *i,* and Y is the estimated number of households in the population, is:

$$var\left(\frac{X_i}{Y_i}\right) = \frac{var(X_i)}{Y^2} + \frac{X^2 * var(Y)}{Y^4} - \left(\frac{2 * X_i}{Y}\right) * cov\,(X_i, Y)] \quad (2)$$

[8] The CPS modified its sample design in the spring of 1994; hence, three rotation groups (6,7,8) were chosen with the old design and five were chosen with the new design. We have chosen our half-samples such that all three rotation groups under the old sample design are never in the same half-sample.

where:

$$var(X_i) = (X_1 - X_2)^2;$$

$$var(Y) = (Y_1 - Y_2)^2; \text{ and}$$

$$cov(X_i, Y) = (X_1 - X_2) * (Y_1 - Y_2).$$

This yields the estimated within-PSU variance for proportions from a single definition of half-samples.[9] The average from the 30 definitions of half-samples provides the final estimate of the within-PSU component of variance.[10]

7.4 CALCULATION OF THE STANDARD ERRORS

Finally, the estimated variance is calculated by multiplying the estimated within-PSU variance by the 1.06 between-PSU variance adjustment factor. The standard errors reported in the exhibits in this report are simply the square roots of the variances estimated using the above procedures.

Our calculations indicate that for the entire population of U.S. households (sample size 44,730), the standard errors for households in a particular food security category range from 0.07 percentage points (food insecure with severe hunger) to 0.36 percentage points (food secure). For smaller subgroups of the population, the standard errors tend to be larger. For example, for subgroups with sample sizes between 1,000 and 2,000, the standard errors range from 0.28 and 0.58 percentage points for the food insecure with severe hunger; and the standard errors range from 1.29 to 1.87 percentage points for the food secure estimates.

[9] *When* calculating the variance of ratios *where the denominator is the population of interest, the* adjustment for different sized half-samples made for the calculation of the variance of totals is unnecessary, because the differences in sample sizes are already taken into account with the variance of the denominator term and the covariance between the numerator and denominator.

[10] To convert the variances calculated for proportions experiencing food security status *i* into variances for the percent of the population experiencing food security status *i*, multiply the variance for proportions by 10,000 (i.e., 100 squared).

CHAPTER EIGHT
POTENTIAL SOURCES OF BIAS IN PREVALENCE ESTIMATES

One of the main purposes of collecting the CPS food security data and developing food security measures from the data is to estimate the prevalence in the United States of food insecurity and hunger on a consistent basis over time and across population groups. To that end, the continuous-measure food security scales were further developed into the food security status variable, as described in Chapter Four. This chapter addresses the question of whether, assuming that the conceptual and operational definitions of the status variable are acceptable, prevalence estimates based on that categorical variable can be considered unbiased.

Three potential sources of bias are examined here:

- Screening bias, which might result from the fact that the full battery of food security questions was asked of all lower-income, but only some higher-income, households;
- Response bias, which occurs if households systematically paint a too-rosy or too-bleak picture of their circumstances; and
- Random error bias, which can occur when the true prevalences in the population are highly skewed.

It is impossible to present definitive estimates of the bias resulting from any of these potential sources. Such an analysis would require the household classifications produced in this study to be compared to classifications using a separate, authoritative measure of food security, but no such measure exists. The discussions below are therefore largely theoretical and speculative, attempting to provide a perspective on the likelihood of each of the possible types of bias.

The general sense is that each of these three sources may contribute some bias, but that the magnitudes of bias are likely to be small and the biases probably move in counterbalancing directions. Screening can lead only to a downward bias in the estimated prevalence of food insecurity and hunger. Response bias also seems likely to move prevalence estimates downwards. Random error, on the other hand, would probably yield upward bias in prevalence

estimates. The net effect of these countervailing forces cannot be determined with the available data.

8.1 SCREENING BIAS

In order to reduce respondent burden, the full battery of food security questions was applied to higher-income households only if they passed through a set of screening questions. The screen consisted of two main elements. Households were screened out if they had annual household incomes above 185 percent of the federal poverty line ***and*** if they gave no indication of food insufficiency in response to the single-item food sufficiency question and two other screening questions (Q15 and 416). Households that had incomes below 185 percent of poverty, and higher-income households that gave some indication of food insufficiency on the screening questions, were asked the full battery of questions. [1,2]

In total, about 26,000 higher-income households did not pass through the screen and were not asked the battery of food security questions. This amounts to nearly 60 percent of the full sample of around 45,000.

It is possible that some respondents who were screened out would have responded affirmatively to some of the questions used in the food security scales. To the extent that this occurred, the estimated prevalence of food insecurity and hunger is biased downwards.

Although the data do not offer a direct way to assess the bias, some insight is possible through looking at the two main screening criteria separately. Households with incomes above 185 percent of poverty passed through the screen if they answered "sometimes [or] often not enough to eat" on the food sufficiency indicator. Similarly, households indicating no food insufficiency passed through the screen if they had incomes below 185 percent of poverty. The food insecurity prevalence estimates for these households are shown in Exhibit 8-l.

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[1] The food sufficiency question was asked in two forms: a single question with four possible responses (Q1 1 A), and two questions with three and two response categories, respectively (Q1 1 and Q12). In either formulation, all households that answered "sometimes [or] often not enough to eat" passed through the screen and were asked the main battery of questions.

[2] The complete screener included two additional paths through besides income and the food sufficiency response, but those two had the predominant impact on screening decisions.

Exhibit 8-l

PERCENT OF SAMPLE ULTIMATELY CLASSIFIED AS FOOD INSECURE, BY INCOME AND FOOD SUFFICIENCY MEASURE

	Above *185%* of Poverty	Below *185%* of Poverty
No food insufficiency indicated on key screening question	**Unknown**[a]	**16.3%**[b]
Food **insufficiency indicated on key screening question**	**59.2%**[b]	**83.8%**[b]

[a] The proportion is necessarily close to zero: most households in this category were screened out and not asked the full battery of questions. The status variable classifies all of these households as Food Secure. A few higher-income households passed the screener based on responses to two other questions, indicating potential food insecurity (Q15, Q16).

[b] Cell percentages represent the food security classification of those households described by the row and column headings. The upper-right cell, for instance, shows that among households that indicated no food insufficiency on the key screening question but had incomes below 185 percent of the poverty line, 16.3 percent are classified as Food Insecure. This includes households classified into any of the three food insecure categories on the 12-month status variable. The three categories are: Food Insecure with Hunger not Evident, Food Insecure with Moderate (Adult) Hunger, and Food Insecure with Severe (Child and Severe Adult) Hunger.

As the exhibit indicates, the food sufficiency item is a fairly powerful screen for food insecurity, A majority of households that indicated food insufficiency on this key screening question were subsequently classified as food insecure on the basis of the full battery of questions. Even among those who reported incomes above 185 percent of poverty, nearly 60 percent of those who indicated food insufficiency on this screening question are classified as food insecure on the scale. On the other hand, the food insecurity rate is only about 16 percent for those households who indicated no food insufficiency on the screening question but were given the full battery of questions because their incomes were below 185 percent of the poverty line.

These figures imply that the percentage of screened-out households who would have been classified as food insecure had they received the full battery of questions is probably very low, but probably not zero. It is therefore likely that the screening procedure imparts a small downward bias to the estimated prevalence of food insecurity.

8.2 RESPONSE BIAS

In assessing response bias, the concern is that survey respondents may, on average, respond to some or all questions in the instrument in a way that systematically portrays the household as more food insecure or less food insecure than its true condition.

Response bias can be accurately judged only by comparing survey responses or scale values to a more definitive measure of the condition. No such definitive measure is available in the present study, however.

The only available indications of bias come from researchers who have been involved in previous efforts to develop measures of food insecurity and hunger. This evidence, largely impressionistic and anecdotal, suggests that survey respondents have some tendency to portray their condition as ***less severe*** than reality, but little tendency to exaggerate their problem. The principal motivations are perceived to be:

- ***Pride/shame*** — a desire not to reveal to an outsider (the interviewer) a condition that the respondent believes could reduce the dignity of his or her image;
- ***Fear of government intervention*** — particularly among low-income households with children, a fear that children might be removed from the household;
- ***Things could be worse*** — households who have experienced more severe conditions than at present may consider their current situation not to be a problem. This is believed to be especially likely for elderly persons who recall the depression of the 1930s;
- ***Reduced standards*** — persons living at a particular level of food insecurity may perceive it to be normal, and may not answer affirmatively to questions about cutting meal size or eating less than they feel they should. At consistently low levels of food intake, individuals may not experience the physical sensation of hunger that a food secure person would experience with the same level of intake. Elderly persons with diminished appetite may not perceive low food intake levels to be problematic.

The response patterns for the CPS food security data provide very little basis for assessing the likelihood or magnitude of any of these potential sources of downward response bias. One point worth noting, however, is that households with elderly members are estimated to have somewhat lower prevalences of food insecurity and hunger than other types of households. This would be consistent with the possible under-reporting biases mentioned for

the elderly, but this analysis cannot distinguish between this and alternative possible reasons for low prevalence of food insecurity in elderly households.

8.3 RANDOM ERROR IN SURVEY RESPONSES

If all respondents have no inclination to portray their situation as better or worse than their true condition, some questions will still be answered inappropriately by some respondents. This may occur because the respondent is confused or not paying attention. It may occur because the question has a legitimate interpretation in addition to the predominant interpretation intended by the survey designers. It may occur because the interviewer hears or records the answer incorrectly. Such errors have no inherent bias: a respondent who should say "yes" is as likely to say "no" as conversely. For present purposes, we consider these errors random.

If the population is roughly evenly divided with respect to the phenomenon being measured, random response error does not lead to bias in prevalence estimates. That is, the number of households who are truly food secure but erroneously classified as food insecure would be offset by an equal number of truly food insecure households who are erroneously classified as food secure.

If the population distribution is highly skewed, however, random error can result in biased prevalence estimates. [3] An example helps to illustrate the issue. Suppose that 90 percent of the population is truly food secure, and 10 percent is truly food insecure. Suppose further that each group has a 10 percent probability of giving responses that cause households to be misclassified. It follows that 9 percent of the population (.9 x . 1) is truly food secure but misclassified as food insecure, whereas just 1 percent of the population (. 1 x . 1) is truly food insecure but misclassified as food secure. In this example, the estimated prevalence of food insecurity would be 18 percent, which means that it has a substantial upward bias relative to the true prevalence of 10 percent.

The best way to assess the extent of this bias would be to compare the classifications used in the study to an independent and definitive measure of food insecurity. Such an assessment would determine both the sensitivity of the classification (the probability that a truly food insecure household would be correctly identified) and its specificity (the probability that

[3] See Habicht and Meyers (1991) for a detailed discussion of this issue.

a truly food secure household would be correctly classified). In the absence of an independent and definitive measure, any analysis is essentially hypothetical.

Some perspective on the issue can be obtained by considering the nature of the food security scale. Fundamentally, a household's value on the scale of severity of food insecurity, and hence its classification into one of the food security status categories, is determined by the number of questions it answers affirmatively. Exhibit 8-2 shows the distribution of households without children, for whom ten questions in the food security battery are applicable and used in the 12-month scale.[4] Among these households, 63 percent were screened out and an additional 24 percent gave negative answers to all ten questions (first row). The percentages in the remaining categories range from 3.3 percent to 0.3 percent, generally declining as the number of affirmatives increases.

Exhibit 8-2

PERCENT OF SAMPLE HOUSEHOLDS WITHOUT CHILDREN BY NUMBER OF AFFIRMATIVE RESPONSES

Screened out or no affirmatives	87.0%
One	3.3%
Two	2.2%
Three (food insecure with hunger not evident)[a]	2.4%
Four	1.1%
Five	1.0%
Six (food insecure with evidence of moderate (adult) hunger[a]	1.1%
Seven	0.8%
Eight	0.5%
Nine (food insecure with evidence severe (child and severe adult) hunger)[a]	0.3%
Ten	0.4%

[a] Minimum number of affkmatives to be classified into the specified category. Percentages based on unweighted counts.

The exhibit illustrates two important points. First, the response distribution is highly skewed, with the vast bulk of the respondents either screened out or giving no affirmative

[4] For households with children, 18 questions were applicable and used in the 12-month scale.

responses. It is reasonable to assume that the true distribution of food insecurity in the population is similarly skewed.

Second, the greatest potential source of upward bias in the prevalence estimates lies in that portion Of the population that either should have been screened out or should have given no positive responses. Assume that the true distribution is close to the observed distribution, such that 87 percent or more of all households should be in these first two categories (first row of the table). A relatively low rate of random response error among this group could misclassify a substantial number of households into other categories in the table.

The distribution shown in the table also sets an upper bound on the possible level of random response error leading to false positives. If absolutely no households should have answered any of the questions affirmatively — i.e., if 100 percent of the households should have been in the first two categories — the implied rate of random response error would be 13 percent. It is obviously unreasonable to believe that no one ever gave an affirmative response correctly. Thus, the true rate of random response error must be well under this upper bound.

A key question in assessing the likely level of random response error is how the error might be distributed across the possible levels of the scale. It seems reasonable to believe that small errors would be more common than large errors. That is, if a household should not have answered any questions affirmatively, it would be more likely to give one erroneous affirmative than two; two erroneous affirmatives would be more likely than three; and so on.

If all households responding in error made errors in just one response, prevalence estimation bias would necessarily be extremely small. Households that should give zero affirmative responses (the largest group of households) would give no more than one. Households that give just one affirmative response are classified as food secure. Thus, no one in the largest group of households would be misclassified into the wrong food security status. The only groups that could bias the prevalence estimates in this situation would be those adjacent to the dividing lines between food security status categories. For example, the first dividing line comes between households with two affirmative responses (classified as food secure) and those with three affirmatives (classified as food insecure without hunger). Some households that should give two affirmative responses might give three, and thus be misclassified as food insecure, and some who should give three affirmatives might give two, and thus be misclassified

as food secure. Because the two adjacent groups are quite similar in size, however, no substantial bias would occur even if the probability of error were extremely high.[5]

Putting these various considerations together, the key question is, what percent of the households who should give zero affirmative responses (the dominant population group) actually give three or more affirmatives, thereby contributing bias to the prevalence estimates? It seems unlikely that this percentage is large, which would mean that the prevalence estimates are not strongly biased. As noted at the outset, however, it is not possible to go beyond this kind of speculative analysis without a separate and more definitive measure of food insecurity and hunger.

8.4 SUMMARY

This analysis considered three possible sources of bias in prevalence estimates. Two of the three factors (screening bias and response bias) seem likely to mean that the estimates understate the extent of food insecurity in the population. One factor (random error) seems likely to work in the opposite direction. Of these three factors, only one — the possible tendency among respondents to underreport the condition being measured — seems capable of producing more than a small bias, and this possible downward response bias is speculative only. Thus, although the probable direction of any net or overall bias may be downward, its actual direction is indeterminant and its magnitude is most likely to be small.

[5] None of the pairs of adjacent groups differ in size by more than 0.2 percentage points. Thus, a 100 percent error rate would yield a bias in the prevalence estimate of just that amount: 0.2 percentage points.

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Appendix A

REVIEW OF LITERATURE FROM PHYSIOLOGY AND CLINICAL NUTRITION RESEARCH ADDRESSING THE NATURE OF HUNGER

APPENDIX A

REVIEW OF LITERATURE FROM PHYSIOLOGY AND CLINICAL NUTRITION RESEARCH ADDRESSING THE NATURE OF HUNGER

The literature summarized below was reviewed to answer two questions that are central to identifying conditions of actual hunger, defined as "the uneasy or painful sensation caused by a lack of food," as experienced within resource-constrained, food-insecure households. These questions are:

1. Are subjective reports of hunger reliable as indicators of a measurable level of food deprivation?

2. Is reduction in food intake a reasonable indicator or precursor of "the uneasy or painful sensation caused by a lack of food," or hunger?

The literature does not yield an unequivocal answer to the first question, though in sum it supports the validity of subjective reports of hunger. There is, however, considerable heterogeneity both in the experience of sensations reported as hunger (or associated with hunger) and in the extent to which these sensations are predictive of food intake. Moreover, there is not a one-to-one correspondence between the length of food deprivation and the intensity of sensations reported as hunger. A number of factors appear to condition the relation between food intake and physical sensations of hunger.

Regarding the second question, there is fairly strong support in the literature for the view that reduced food intake does lead to physical sensations of hunger. Up to a point, the intensity of such sensations are positively associated with the extent of food deprivation. Under conditions of prolonged fasting, however, the physical sensations associated with hunger diminish in intensity, and are generally extinguished altogether.

A reasonable conclusion from these studies is that people who experience patterns of undesired reductions in food intake below usual levels, such as may occur with severe limitation of household resources, do experience physical sensations of hunger.

Summary of Physiological Literature

Vanderweele and Geiselman (1986) review the proceedings of a symposium addressing relationships between appetite and need states in animals (including humans) that was part of the 1985 American Psychology Association Annual Meetings.- Though most of the research presented in this symposium involved animal experiments, several themes of relevance to the current discussion emerged.

Geiselman presents results that relate to the distinction between "hunger" (defined as "food drive that occurs in response to post-absorptive stimulation") and "appetite" (defined as "food incentive occurring in response to pre-absorptive stimulation such as the anticipation, sight, smell, or taste of palatable food"). Results observed following infusion of hexoses into different locations within the gastric systems of laboratory animals lead Geiselman to conclude that both hunger and appetite involve common underlying physiologic mechanisms.

Vanderweele and Geisehnan characterize the research presented at this symposium as generally supporting the hypothesis that both hedonic and physiological factors operate in the regulation of food intake behaviors in humans and other animals, and that it is thus unlikely that appetite and hunger can be completely separated. These findings provide some support for the experience of an "uneasy or painful sensation caused by a lack of food" when meal size is reduced below usual levels, or when meals are skipped, in that they indicate such sensations can arise both from physiological factors (e.g., rates of gastric emptying, intestinal absorption of nutrients, lipogenesis, and changes in blood glucose levels), and learned or conditioned associations (e.g., related to social and cultural factors, food preferences, palatability of foods, and time schedules regarding meals or other instances of food intake).

DeCastro and Elmore (1987) investigated the relationship between the subjective state of hunger and objective food intake among 31 free-living adults (9 male and 22 female) using a diary self-report method in which subjects recorded everything they ate or drank, the time of occurrence, and their degree of subjective hunger at the beginning of each eating occurrence over seven consecutive days. Food intake records were used to estimate stomach contents over time, based on a previously established formula.

DeCastro and Elmore conclude that the results of this study indicate that the intensity of self-reported hunger is dependent primarily on the contents of the stomach. This conclusion is based primarily on the finding of significant positive correlations between self-rated subjective

hunger at the beginning of meals and the duration of the pre-meal interval, significant negative correlations between self-rated subjective hunger and estimated pre-meal contents of the stomach, and significant multiple regression coefficients for estimated components of the contents of the stomach when regressed against the intensity of self-rated hunger. Total protein and food energy in the stomach contents were found to be the most salient factors in determining subjective hunger.

These researchers conclude that their results indicate that, as the stomach empties (a process occurring over a few hours), especially of protein, the internal subjective state of hunger increases. This leads them to observe that "the longer its [sic] been since the last time the subject ate, the hungrier they report themselves to be."

This study indicates that the contents of the stomach and stomach emptying are primary factors influencing the intensity of the "uneasy or painful sensations" reported as hunger. It also supports the likelihood that persons who reduce the size of their meals, or who skip meals, do experience hunger, because these behaviors make it more likely that the stomach contains little protein and few calories of food energy equivalent.

***Wardle** (1987)* used three separate methods to track hunger among healthy women over a two-week period (including a behavioral method — amount of food intake; a physiological method — stimulated salivation prior to meals; and subjective reporting — paper and pencil recordings of the intensity of global hunger sensations, selection of experienced hunger symptoms, feeling of fullness, and type of foods selected). Results showed that ratings of hunger symptoms, preferred foods, global hunger, and satiety were sensitive to the length of time subjects were deprived of food and the content of the previous intake.

The behavioral, physiological, and subjective measures of hunger employed were consistent, reliable, and stable over time. Thus, this study indicates that the intensity of self-reported hunger increases with the length of the deprivation period. Moreover, because the usual intervals between intake episodes in the study were comparable to normal intervals between meals, these results support the likelihood that persons in food insecure households who cut the size of their meals, or who skip meals, experience "uneasy or painful sensations" that they report as hunger.

Harris and Wardle (1987) used a modified version of the 36-item "Monello and Mayer Hunger-Satiety Questionnaire" to assess hunger symptoms among two groups of subjects in pre-

meal and post-meal periods (group 1 — 274 female and 97 male undergraduate and adult education students; group 2 — 73 female and 84 male medical students). These researchers found a significant relationship between hours of deprivation and level of hunger reported. An unexpected finding from this study is the wide heterogeneity in hunger symptoms reported by subjects, with unexpectedly small numbers (e.g., 4-7) of symptoms reported in common by most subjects. The most commonly reported "uneasy or painful" symptoms were: emptiness, ache, urge to eat, rumbling, and hollowness. The relatively small numbers of commonly-endorsed symptoms lead these researchers to the conclusion that their results indicate that neither food deprivation nor reported hunger necessarily imply the perception of any particular bodily sensations. They further conclude that "it proved impossible to identify a specific subset or constellation of hunger symptoms which were characteristically experienced by hungry people. "

This study is important for two reasons. First, it supports the contention that persons who cut meal size, or who skip meals, experience hunger, by showing that the longer the interval between episodes of food intake, the hungrier subjects report themselves to be. In addition, this study indicates that there is considerable heterogeneity in the way people experience the "uneasy or painful sensation caused by a lack of food. " As Mattes and Friedman (1993) point out, the sensation of hunger is reported to occur in a variety of ways in many parts of the body. People experience a wide variety of sensations that they report as hunger, and the intensity of these sensations clearly increases (up to a point) as the period of deprivation increases.

Sepple and Read (1989) carried out an experiment in which ten normal healthy male volunteers were intubated with instrumentation to enable precise measurement of blood glucose levels, gastric emptying, and intestinal motor activity. Subjects who had fasted overnight were monitored for six hours, with measurements taken every 20-30 minutes before and after eating a meal. Subjects also completed a short questionnaire at 30-minute intervals to assess subjective ratings of hunger, fullness, anxiety, nausea, desire to eat, and other sensations. Intensity of each sensation was indicated by marking line analogues.

Sepple and Read found that eating the meal reduced the intensity of hunger ratings in all subjects, and totally abolished hunger in seven of the ten. The time for hunger to recur varied from 90-360 minutes, but was less than two hours for seven of the ten subjects. Once hunger ratings began to increase, they rose steadily in all subjects.

These researchers' results do not support the hypothesis that hunger is related to a decline in blood glucose concentration, but do strongly support the role of gastric emptying. A large and significant correlation was found between the time taken for 90 percent of the meal to empty and the time hunger started to increase ($r = 0.75$, $p < 0.02$). Maximum hunger ratings were obtained in all subjects when less than 10 percent of the meal remained in the stomach.

Sepple and Read conclude that their results are most compatible with the hypothesis that the sensation of hunger is induced by a reduction in stimulation of receptors in the upper intestine by nutrients present in food. Further support for this hypothesis was provided by observed appearance of fasting motor patterns in the upper intestine (also thought to reflect declining levels of nutrients) only at peak hunger levels in most subjects, and always after hunger had begun to increase.

The importance of the results of this clinical experiment is that it provides strong objective physiological evidence that emergence of the sensation of hunger accompanies, and is strongly related to, the emptying of food from the gastrointestinal tract, and that this occurs within a relatively short time period (about 2-4 hours). These results support the expectation that persons who reduce their food intake below usual levels, or who skip meals altogether, do experience sensations of hunger.

Mattes (1990) examined the relationship between self-reported hunger ratings and food intake in a study involving twelve normal male and twelve normal female subjects whose food intake and hunger ratings were recorded every waking hour for seven consecutive days. Although Mattes did not fmd a significant correlation between hunger ratings and food intake during the previous hour, he did find moderately large and significant correlations between hunger ratings and intake during the following hour.

Mattes observed two clear peaks in both the intensity of hunger ratings and food intake during each day, occurring at approximately 1200 and 1800 hours, or corresponding to the mid-day and evening mealtimes. Comparing difference scores for hunger ratings at the beginning and end of two-hour periods during which food was eaten in the intervening period, or not, Mattes found declines in hunger ratings over periods when eating occurred, and increases in hunger ratings over periods during which eating did not occur. The changes in ratings over the eating versus the no-eating periods were significant.

Curiously, Mattes found markedly different relationships between self-reported hunger and food intake on weekdays compared to weekend days. He posits that this suggests that eating in response to increased hunger sensations may involve an "entrained," or learned component, perhaps related to weekday work schedules. The differences observed over weekdays and weekend days are not consistent, Mattes suggests, with a strict energy depletion-hunger association, suggesting instead the influence of multiple factors.

Mattes' results indicate that the intensity of sensations of hunger among humans has two observable peaks during each day, corresponding closely to the timing of the mid-day and evening meals. More importantly, analysis of changes in the intensity of hunger ratings over time periods approaching usual inter-meal intervals (two hours) shows significant increases in hunger ratings over intervals in which eating does not occur, and significant declines in hunger ratings over intervals in which eating does occur.

Finally, the variations observed in the relationship between hunger ratings and food intake on weekdays versus weekend days supports the operation of a learned component in the relationship. Associations based on entrained or learned responses to hunger are consistent with social and cultural factors influencing the relationship between hunger and food intake, and with the experience of hunger if usual patterns of food intake are interrupted.

Ogden and Wardle (1990) examined the relationship between cognitive restraint of food intake and internal cues provided by caloric content of a pre-load, or pre-meal, intake. These authors found a significant effect of time since previous intake on subjective ratings of hunger. Subjects responded to an increased period of food deprivation (between morning intake and lunch) with an increase in subjective hunger ratings. Moreover, subjects with higher-calorie pre-loads at previous intake rated their subjective sensation of hunger significantly lower than subjects with low-calorie intakes. This indicates a significant effect of internal cues related to caloric content of previous intake on the level of subjective hunger sensation.

This study supports the general finding from other research that longer intervals between meals, or occurrences of food intake, lead to higher ratings of the sensation of hunger. It also indicates that persons who cut the size of their meals, or who skip meals, are more likely to experience the "uneasy or painful sensation caused by a lack of food" more intensely as the immediate post-meal time interval increases.

In one of the more unusual studies reviewed, ***DeCastro*** (1991) used seven-day food intake diaries with 121 male and 194 female adult subjects, together with pre- and post-meal implementations of a seven-point "full-hungry" scale, to assess food intake and hunger across seasons of the year. DeCastro not only found that subjects self-rated themselves as significantly hungrier (less sated) before meals than after meals, but also that, overall, subjects reported themselves significantly less hungry before meals eaten in the summer than in the winter or spring. Moreover, subjects reported themselves significantly hungrier (less sated) after meals eaten in the summer than in the winter or spring, and in the fall than in the winter.

DeCastro concludes that these results indicate that ingestion of a meal during the summer and fall leaves people hungrier than in the winter and spring. De Castro also finds that food and nutrient intakes are significantly greater in the summer and fall, with a mean increase of 14 percent in the fall. This study not only indicates that people who cut meal size or skip meals are more likely to report experiencing hunger than those who eat meals on their accustomed schedule, but that there is also seasonal variation in the intensity of hunger under these circumstances.

Lappalainen et al. (1990) examine hunger and food craving among two groups of obese patients. One group was fed a protein-sparing, well-balanced low-calorie diet for three weeks (1200-1600 Kcal per day), and the other provided "fasting therapy" in which food intake was reduced first to 800 Kcal per day, then to 200 Kcal per day over three days, and maintained at *200* Kcal per day for 19 additional days.

These researchers found that both frequency of hunger/craving responses and reactivity to food stimuli (reported changes in hunger state when shown pictures of food) decreased among the fasting group, but not among the group fed the protein-rich low-calorie diet. During the last (third) week of fasting, reactivity to food stimuli was completely abolished, and frequency of hunger/craving responses was reduced nearly to zero.

These results indicate that persons who reduce their food intake below its usual level (e.g., by cutting meal size or skipping meals) are likely to experience hunger and food-craving sensations, but if food intake is reduced dramatically and maintained at a very low level (as in prolonged fasting, or not having anything to eat for several days), sensations of hunger or food craving actually decline, and may disappear altogether.

Mattes and Friedman (1993) review several studies measuring factors associated with variability in subjective reporting of hunger. These authors report four definitions of hunger appearing in the literature reviewed:

1. Hunger is frequently operationally defined in terms of experimental or external conditions, such as the number of hours of food deprivation, or the size of the last meal. Emphasis is on attempting to make the term more objective or operational.

2. Hunger is used to refer to an intervening motivational state, or drive, that links experimental treatments or antecedent conditions (e.g., food deprivation) with behaviors aimed at obtaining food. Intensity of hunger is then inferred from either verbal reports of the desire for food, or willingness to perform a task for food.

3. Hunger is (most commonly) used to describe the subjective sensations associated with the need for food. The focus here is on the experience of various bodily states, sensations, or feelings, not on their causes.

4. Hunger is viewed as a physiological or metabolic state that results from a lack of energy or nutrients. This deficit state, which is detected by the nervous system, can modify eating behavior and food intake, and produce various subjective sensations collectively referred to as hunger. The emphasis with this usage is on physiological cause(s), not on the somatic manifestations of the need for food.

Mattes and Friedman focus their review primarily on the latter two of these definitions (i.e., hunger as a subjective experience, and hunger as a physiologically- or metabolically-based state resulting from the lack of energy or nutrients), expressing the view that "defiig hunger in terms of a subjective or physiological state deals more directly with the experience and mechanisms of hunger, and therefore appears more relevant to basic research and clinical practice concerns. " These researchers report findings of moderate and statistically significant correlations between reduced food intake and subjective reports of hunger, though the focus of their review is more on self-reported hunger as a predictor of food intake, rather than on whether reduction in food intake leads to the sensation of hunger.

Mattes and Friedman report findings from a study involving 800 individuals' responses to hypothetical fasts of varying durations wherein, under conditions described as extreme hunger, more than 90 percent of subjects indicated they experienced gastric sensations. This percentage declined to 50 percent of subjects reporting gastric sensations two hours prior to a typical meal. Similar patterns were noted for the mouth, throat, head, and general bodily sensations, although the proportion of subjects reporting these sites was smaller. Differences were observed by

gender and age, with mouth sensations more common among males than females, and head sensations more frequently reported by adults than by adolescents.

Mattes and Friedman also report results from their own research using open-ended questionnaires administered to 83 university students (45 male and 38 female), asking them to describe sensations associated with hunger of varying intensity (from slightly hungry to extremely hungry).' Gastric sensations were also the most commonly reported symptom among subjects in this study, with 55 percent reporting stomach growls and 34 percent reporting stomach aches. When asked to report the body sites where sensations associated with different levels of intensity of hunger were experienced, 70 percent of subjects reported sensations in their stomachs when they were "slightly" hungry, 82 percent when they were "moderately" hungry, 92 percent when they were "very" hungry, and 88 percent when they were "extremely" hungry. Fewer subjects reported sensations in their heads, with 10 percent experiencing hunger-related sensations when "slightly" hungry, increasing to 43 percent when they were "extremely" hungry.

Mattes and Friedman identify a number of physiological factors related to the sensation of hunger, including reduction in gastric distention (reduced feeling of pressure caused by emptying of food from the stomach), metabolic signals transmitted from the liver and small intestine, and sensory input from the oral cavity. All of these factors are conceptually consistent with experience of an "uneasy or painful sensation caused by a lack of food" when meals are cut or skipped.

Read et al. (1994) review research on the role of gastrointestinal processes in regulation of food intake in humans. These authors emphasize the role of factors associated with emptying of nutrients from the upper small intestine (which occurs within a relatively short period after ingestion of food) in signaling the sensation of hunger. They also discuss the phenomenon of nutrient adaptation, wherein humans (and other animals) adapt to a particular pattern of availability of energy and other nutrients, leading to moderation of the sensations of hunger and satiety under persistent conditions of reduced intake. This adaptive process (also noted by Mattes and Friedman (1993) and Lappalainen et ***al.*** **(1993),** and discussed above) leads to a reduction in the intensity of hunger sensation, and its eventual extinction after prolonged fasting, and implies that deviation from normal eating patterns (such as would occur if meals are cut or skipped) can lead to more intense subjective sensations of hunger than would occur under more prolonged intake reduction.

Read *et al.* (1994) conclude that the human gastrointestinal tract is compatible with the observed tendency of humans to eat three or four meals a day, and that the gastrointestinal mechanisms that trigger both initiation and termination of eating behavior operate within a relatively short time period (e.g., a few hours). This implies a very high likelihood that recurrent reduction of food intake by cutting meal size or skipping meals because of insufficient money to buy food will lead to the experience of an "uneasy or painful sensation caused by a lack of food." Adaptation of the gastrointestinal system to prolonged changes in food or nutrient availability may moderate the intensity of this sensation if intake reduction is prolonged or stabilized at reduced levels.

Rolls (1993) examines appetite, hunger, and satiety among the elderly population, reviewing a number of studies addressing causes and consequences of reduced food intake, decline in appetite and olfactory and gustatory sensory acuity, and reduction of sensory-specific satiety among elderly persons. Rolls also reports results of her own research on decline in sensory-specific satiety among older persons.

Satiety is generally the converse of hunger; the hungrier one is, the less sated they are. Satiety is both the complex of sensations that reduce the motivation to eat as more food is ingested, and the declining palatability of specific foods as they are ingested. Sensory-specific satiety is the decline in pleasantness of a particular food following consumption of that food. Sensory-specific satiety is associated with decreased consumption of the previously-eaten food and a shift in consumption to other food choices. It appears to decrease, and even disappear, among persons over age 65 years.

This study is of interest not because it provides evidence that persons who cut meal size or skip meals experience hunger, but because it suggests that the nature of the "uneasy or painful sensation caused by a lack of food," or the sensation of hunger, changes in ways that may reduce or mask its intensity among elderly persons. To the extent this occurs, elderly persons may actually under-report their experience of hunger.

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Appendix B

PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS (30-DAY SCALE)

Exhibit B-l

PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS: 30-DAY SCALE

[Numbers in thousands. Poverty status refers to household status in the preceding year.] Characteristic	Total	No Food Insecurity with Hunger Evident*		Food Insecure with Moderate Hunger Evident[b]		Food Insecure with Severe Hunger Evident[c]	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Household Composition							
All races:							
With children under 18 yrs	38,113	36,877	96.8	1031.9	2.7	203.6	0.5
With children under 6 yrs	18,282	17,661	96.6	519.8	2.8	101.0	0.6
With elderly;[d] no children	27,805	27,567	99.1	201.9	0.7	36.6	0.1
With no elderly or child	34,291	33,359	97.3	725.0	2.1	207.3	0.6
All household types	100,210	97,803	97.6	1958.8	2.0	447.5	0.4
White:							
All households							
With children under 18 yrs	30,438	29,622	97.3	686.3	2.2	130.1	0.4
With children under 6 yrs	14,467	14,048	97.1	358.3	2.5	60.4	0.4
With elderly; no children	25,012	24,838	99.3	150.7	0.6	23.8	0.1
With no elderly or chid	29,163	28,517	97.8	507.0	1.7	139.1	0.5
Black:							
All households							
With children under 18 yrs	5,841	5,485	93.9	298.4	5.1	57.6	1.5
With children under 6 yrs	2,826	2,669	94.4	130.0	4.6	27.2	1.0
With elderly; no children	2,321	2,265	97.6	43.4	1.9	12.0	0.5
With no elderly or child	3,852	3,598	93.4	197.1	5.1	56.4	1.5
Other:							
All households							
With children under 18 yrs	1,833	1,770	96.6	47.2	2.6	16.0	0.9
With children under 6 yrs	989	944	95.5	32.0	3.2	13.4	1.4
With elderly; no children	472	464	98.2	7.9	1.7	0.9	0.2
With no elderly or child	1,276	1,244	97.4	20.9	1.6	1.2	0.9
Hispanic:[e]							
All households							
With children under 18 yrs	4,475	4,274	95.5	160.6	3.6	41.3	0.9
With children under 6 yrs	2,539	2,379	93.7	122.2	4.8	6.9	1.5
With elderly; no children	1,151	1,115	96.9	27.3	2.4	8.4	0.7
With no elderly or child	2,075	1,991	95.9	47.2	2.3	37.3	1.8

Notes at end of exhibit

Exhibit B-l *(continued)*

PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS: 30-DAY SCALE

[Numbers in thousands. Poverty status refers to household status in the preceding year.] Characteristic	Total	No Food Insecurity with Hunger Evident'		Food Insecure with Moderate Hunger Evident[b]		Food Insecure with Severe Hunger Evident'	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Household Income Category' (All *races and household types)*							
Below $10,000	14,977	13,893	92.8	822.0	5.5	262.4	1.8
$10,000 - $19,999	16,717	16,043	96.0	568.4	3.4	105.2	0.6
$20,000 - $29,999	15,625	15,319	98.0	268.2	1.7	37.7	0.2
$30,000 to $39,999	12,149	12.046	99.2	87.2	0.7	15.9	0.1
$40,000 - $49,999	8,539	8,488	99.4	43.2	0.5	8.3	0.1
Above $50,000	**22,370**	**22,319**	**99.8**	**50.3**	**0.2**	**0.X**	**
Household Income-to-Poverty Ratio' *(All races and household types)*							
Under 0.50	5,545	4,987	89.9	415.7	7.5	142.2	2.6
Under 1.00	15,808	14,617	92.5	904.2	5.7	287.2	1.8
Under 1.30	21,810	20,304	93.1	1178.6	5.4	326.9	1.5
Under 1.85	35,115	33,239	94.7	1503.7	4.3	372.0	1.1
1.85 and over	65,094	64,564	99.2	455.1	0.7	75.5	0.1
Household Relationship *(AU races)*							
Households with children under 18	38,113	36,877	96.8	1031.9	2.7	203.6	0.5
Married couple families	26,841	26,347	98.2	445.2	1.7	48.9	0.2
Female head, no spouse	8,941	8,290	92.7	509.6	5.7	140.9	1.6
Male head, no spouse	2,332	2,241	96.1	77.1	3.3	13.8	0.6
Households with no children or	34,291	33,359	97.3	725.0	2.1	207.3	0.6
Living alone	13,724	13,151	95.8	434.5	3.2	138.6	1
Households with elderly but no	27,805	27,567	99.1	201.9	0.7	36.6	0.1
Living alone	11,699	11,544	98.7	131.7	1.1	23.0	0.2
Area of Residence (All *races* and household *types)*							
Inside Metropolitan areas	60,657	59,155	97.5	1215.0	2.0	287.1	0.4
In central city	24,055	23,266	96.7	671.2	2.8	117.7	0.5
Not in central city	36,602	35,889	98.0	543.8	1.5	169.4	0.5
Outside Metropolitan areas	23,877	23,298	97.6	478.0	2.0	100.8	0.4

Notes on next page

Exhibit B-l ***(continued)***

PREVALENCE OF HOUSEHOLD **FOOD** SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS: **30-DAY** SCALE

NOTES:

[a] No or minimal indicators of resource-constrained hunger evident for household members (corresponds to the combined categories of "food secure" and "food secure, hunger not evident" in the 12-month scale).

[b] Multiple indicators of resource-constrained hunger evident for adult household members.

[c] Multiple indicators of resource-constrained hunger evident for children in household and/or indicators of severe adult hunger.

[d] Elderly persons are defined as persons aged 60 years and older in this report.

[e] Persons of Hispanic ethnicity can be of any race.

[f] Income and poverty status refer to household income in a recent 12-month period, varying among rotation groups in the CPS sample. Income is missing for 9.8 percent of households but their income-to-poverty ratio category was imputed by the Census Bureau.

[g] For confidentiality reasons the CPS did not report the area of residence for 15.6 percent of households. The estimates shown are for households with area of residence identified.

Exhibit B-2

STANDARD ERRORS FOR PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS: 30-DAY SCALE

[Numbers in thousands. Poverty status refers to household status in the preceding year.] Characteristic	Sample Size (in ones)	No Food Insecurity with Hunger Evident[a]		Food Insecure with Moderate Hunger Evident[b]		Food Insecure with Severe Hunger Evident[c]	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Household Composition							
AU races:							
With children under 18 yrs	16,914	61	0.16	67	0.18	24	0.06
With children under 6 yrs	7,934	41	0.23	41	0.22	14	0.08
With elderly;[d] no children	12,485	40	0.14	35	0.13	8	0.03
With no elderly or child	15,248	85	0.25	55	0.16	3 8	0.11
All household types	44,647	110	0.11	97	0.10	42	0.04
White:							
All households							
With children under 18 yrs	13,808	51	0.17	52	0.17	18	0.06
With children under 6 yrs	6,391	37	0.25	32	0.22	14	0.10
With elderly; no children	11,283	29	0.12	26	0.11	4	0.02
With no elderly or child	13,137	55	0.19	39	0.13	25	0.09
Black:							
All households							
With children under 18 yrs	2,023	18	0.31	22	0.38	13	0.21
With children under 6 yrs	959	26	0.91	23	0.82	7	0.26
With elderly; no children	926	16	0.68	13	0.57	5	0.21
With no elderly or child	1,370	40	1.03	27	0.69	16	0.43
Other:							
All households							
With children under 18 yrs	1,083	14	0.75	13	0.70	8	0.45
With children under 6 yrs	584	8	0.84	7	0.73	7	0.75
With elderly; no children	276	5	0.98	4	0.94	1	0.14
With no elderly or child	741	8	0.62	7	0.57	7	0.58
Hispanic:[e]							
All households							
With children under 18 yrs	1,529	27	0.61	21	0.48	12	0.28
With children under 6 yrs	857	23	0.90	18	0.69	13	0.49
With elderly; no children	406	10	0.88	7	0.63	5	0.39
With no elderly or child	695	15	0.74	12	0.59	13	0.63

See notes to Exhibit B-l

Exhibit B-2 *(continued)*

STANDARD ERRORS FOR PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS: 30-DAY SCALE

[Numbers in thousands. Poverty status refers to household status in the preceding year.] Characteristic	Sample Size (in ones)	No Food Insecurity with Hunger Evident[a]		Food Insecure with Moderate Hunger Evident[b]		Food Insecure with Severe Hunger Evident[c]	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Household Income Category[f]							
(All races and household types)							
Below $10,000	6,368	42	0.28	47	0.31	45	0.30
$10,000 - $19,999	7,651	69	0.41	59	0.35	12	0.07
$20,000 - $29,999	7,202	40	0.26	33	0.21	13	0.09
$30,000 to $39,999	5,808	19	0.15	18	0.15	6	0.05
$40,000 - $49,999	4,037	15	0.18	15	0.18	5	0.05
Above $50,000	10,690	16	0.07	16	0.07	1	0.01
Household Income-to-Poverty[f]							
(All races and household types)							
Under 0.50	2,219	25	0.45	25	0.45	30	0.54
Under 1.00	6,650	51	0.32	61	0.38	42	0.26
Under 1.30	9,384	85	0.39	83	0.38	50	0.23
Under 1.85	15,594	103	0.29	92	0.26	50	0.14
1.85 and over	29,053	25	0.04	18	0.03	17	0.03
Household Relationship							
(All races)							
Households with children under 18	16,914	61	0.16	67	0.18	24	0.06
Married couple families	12,295	39	0.15	40	0.15	7	0.03
**Female head, no spouse	3,677	67	0.75	66	0.73	16	0.18
**Male head, no spouse	942	15	0.63	12	0.53	8	0.33
Households with no children or	15,248	85	0.25	55	0.16	38	0.11
Living alone	5,941	60	0.44	38	0.28	32	0.23
Households with elderly but no	12,485	40	0.14	35	0.13	8	0.03
Living alone	5,222	31	0.26	23	0.20	9	0.07
Area of Residence:							
(All races and household types)							
Inside Metropolitan areas	24,214	91	0.15	71	0.12	32	0.05
In central city	9,606	74	0.30	51	0.21	28	0.11
Not in central city	14,608	34	0.09	29	0.08	15	0.04
Outside Metropolitan areas	12,532	40	0.17	29	0.12	22	0.09

See notes to Exhibit B-1

APPENDIX C

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6879

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Technical Report

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Report

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Household Food Security in the United States in 1995
Summary Report

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Evaluation

Household Food Security in the United States in 1995

Summary Report of the Food Security Measurement Project

September 1997

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TABLE OF CONTENTS

EXECUTIVE SUMMARY i

Chapter One FOOD SECURITY AND HUNGER MEASUREMENT IN THE UNITEDSTATES . . . . . .

Introduction 1
Food Insecurity and Hunger Measurement-Background 2
Food Insecurity and Hunger Measurement-Conceptual Basis 4
The Hypothesis of Hunger as Severe Food Insecurity 7
The Role of Food Security Measurement 9
Conclusion 11

Chapter Two THE FOOD SECURITY SUPPLEMENT TO THE CURRENT POPULATIONSURVEY.. 13

The Food Security Measurement and Research Conference 13
Questions in the Food Security Survey Supplement 15
The Current Population Survey Sample 17
The CPS Food Security Supplement Sample 18

Chapter Three THE FOOD SECURITY MEASUREMENT SCALE 21

Scale Development 21
12-Month and 30-Day Scales 23
Questions Used in the Scale 24
Relative Severity of Questions in the Scale 27
Household Values on the Scale 29
Overview of Scale Development Results 31

Chapter Four THE FOOD SECURITY STATUS MEASURE 33

Defining Ranges on the Food Security Scale 36
Food Insecure 37
Food Insecure with Moderate Hunger 38
Food Insecure with Severe Hunger 41
Response Profile of Households in the Four Categories 42
Relationship of Food Security Status to Other Measures 44

Chapter Five PREVALENCE OF FOOD INSECURITY AND HUNGER 47

Prevalence Estimates 47
Participation in Food Assistance Programs 54
State-Level Food Security Prevalence Estimates 56
Thirty-Day Prevalence Estimates 56
Estimating the Number of Persons in Food-Insecure Households 57
Comparing Food Security Prevalence Estimates from Various Sources 58
Conclusion 60

Chapter Six STRENGTHS AND LIMITATIONS OF THE FOOD SECURITY MEASURE 6 1

Results of the Scaling Analysis 61
Summary of Prevalence Estimates 62
Notes on Validity and Accuracy 62
Future Directions 65

REFERENCES 67

Appendix A SUPPLEMENT TO THE APRIL 1995 CURRENT POPULATION SURVEY

Appendix B QUESTIONS TESTED FOR THE FOOD SECURITY SCALES: UNWEIGHTED RESPONSE FREQUENCIES

Appendix C PREVALENCE ESTIMATES AND STANDARD ERRORS BY STATE

Appendix D ESTIMATED STANDARD ERRORS FOR PREVALENCE TABLES IN CHAPTER FIVE

Appendix E DISTRIBUTION OF PERSONS IN HOUSEHOLDS BY FOOD SECURITY STATUS CLASSIFICATION

Appendix F PARTICIPANTS IN FEDERAL INTERAGENCY WORKING GROUP FOR FOOD SECURITY MEASUREMENT

LIST OF EXHIBITS

Exhibit 2-l	Summary of Food Security Survey Items by Subject Area	15
Exhibit 2-2	Description of the Final Food Security Supplement Sample by Type of Household	20
Exhibit 3-l	Questions Included in the Food Security Scale	25
Exhibit 3-2	Severity Ranking of Questions in Food Security Scale	28
Exhibit 3-3	Population Distribution by Selected Household Scale Values	30
Exhibit 4-l	Severity Ranges on the Food Security Scale	39
Exhibit 4-2	Response Profile by Category	43
Exhibit 4-3	Relationship of the Food Security Status Measure to Other Variables	45
Exhibit 5-l	Prevalence of Household Food Security Status by Selected Characteristics of Households	48
Exhibit 5-2	Percent of Households Receiving Food Assistance in the Past 30 Days, by Food Security Status	55
Exhibit B-l	Responses to Questions Tested for the Food Security Scales	
Exhibit C-l	Estimated Food Security Prevalences by State: Twelve Months Preceding the Survey	
Exhibit C-2	Standard Errors for State Prevalence Estimates: Twelve Months Preceding the Survey	
Exhibit D-l	Standard Errors: Prevalence of Household Food Security Status by Selected Characteristics of Households: 12-Month Scale	
Exhibit E-l	Estimated Distribution of Persons With Selected Characteristics Living in Households with Each Food Security Status: 12-Month Scale	

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For the analysis project itself, the project team benefitted from the contribution of staff in several federal agencies, as well as members of the project's expert review panel. Gary Bickel, Margaret Andrews, and Steven Carlson (USDA, Food and Consumer Service) provided guidance, support, spirited debate, and detailed critiques throughout the project. Thoughtful review and commentary came also from Mark Nord, Donald Rose, and Victor Oliveira (USDA, Economic Research Service), Ronette Briefel (DHHS, Centers for Disease Control and Prevention, National Center for Health Statistics), and Richard Bavier (Office of Management and Budget). Finally, we are especially grateful for the time and effort devoted by the members of the expert review panel listed below, most of whom participated in a group review meeting in Washington and many of whom also provided insightful written reviews.

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EXECUTIVE SUMMARY

In April 1995, the U.S. Bureau of the Census conducted the first Food Security Supplement to its regular Current Population Survey (CPS). With about 45,000 household interviews, the Food Security Supplement provides the basis for the first comprehensive measurement of food insecurity and hunger in a nationally-representative sample of U.S. households. This survey is the cornerstone of the food security measurement project begun in 1992 to carry out a key task assigned by the Ten-Year Comprehensive Plan for the National Nutrition Monitoring and Related Research Program (NNMRRP). The task is to develop a standard measure of food insecurity and hunger for the United States, for use at national, state, and local levels.

This project has been a cooperative undertaking by the responsible federal government agencies under the leadership of the Food and Consumer Service (FCS) of the U.S. Department of Agriculture jointly with the National Center for Health Statistics/Centers for Disease Control and Prevention (NCHS) of the Department of Health and Human Services. Academic and other private-sector research experts in the field of food security and hunger measurement have aided the project from its beginning, achieving a substantial public/private partnership in the effort to develop a state-of-the-art food security survey questionnaire, statistical measurement method, and food insecurity and hunger measures and prevalence estimates for the nation.

The present study reports the **first** of these national prevalence estimates for food insecurity and hunger for the **12-month** period ending in April 1995, based on the CPS data and applying a sophisticated statistical measurement method that creates a detailed scale for measuring the underlying level of severity of food insecurity and hunger experienced in U.S. households. Based on this food security scale, a simpler measure is constructed that classifies households into several broad ranges or levels of severity, defining four categories of food security status for US. households:

- food secure,
- food insecure without hunger,
- food insecure with moderate hunger, and
- food insecure with severe hunger.

The categorical measure allows one to estimate the number of American households that experience food insecurity and hunger within each of the broad levels specified. The measure is designed to be useful primarily for monitoring changes in prevalence over time, and comparing prevalence across groups within the population, on a sustained, consistent basis.

Background and Definitions

Food security has been defined briefly as "assured access to enough food for an active, healthy life." The household should have access to enough food, the food should be nutritionally adequate, it should be safe, and the household should be able to obtain it through normal channels. Although all of these dimensions of food security are important, the measure presented here focuses on whether the household has "enough" food, as perceived and reported by adult members of the household. When food insecurity on this central dimension reaches severe levels, actual hunger for household members is the result.

Hunger is defined briefly as "the uneasy or painful sensation caused by a lack of food." The CPS Food Security Supplement aims to measure only that hunger which results from the financial resource constraint of the household-from being unable to afford enough food. The survey does not measure hunger that results from being too busy to eat, from voluntary fasting, from illness, or from any other cause except lack of financial resources. Thus, food insecurity and hunger measured here are clearly related to general income poverty. They focus, however, on only one area of household circumstances, rather than on the general problem of whether resources are adequate to cover all areas of need.

Interest in measuring food insecurity and hunger springs from two sources. First, food security is an important dimension of basic individual and family well-being, analogous to health or housing. Food insecurity and hunger are undesirable in their own right, and possible precursors to more serious health and developmental problems. Monitoring food security is important for understanding one fundamental component of the well-being of the American population and for identifying geographic or other subgroups with particularly undesirable and high-risk conditions.

Second, numerous public and private food assistance programs attempt to ameliorate food insecurity and hunger. Accurate measurement of food insecurity and hunger are important for program planners and policymakers to assess adequately the effectiveness of these programs

in meeting their intended objectives. This need for concrete indicators of program outcomes takes on new importance for federal agencies under the mandate of the 1993 Government Performance and Results Act (GPRA), which requires agencies to give increased, explicit attention to such indicators.

The government's food security measurement effort was built upon extensive private-sector research in the late 1980s that expanded and sharpened the understanding of food security, food insecurity, and hunger. This work led to the development by an expert working group of the American Institute of Nutrition of the following conceptual definitions, which were published by the Life Sciences Research Office (LSRO) of the Federation of American Societies for Experimental Biology (Anderson/AIN/LSRO, 1990):

- *Food security* — "Access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies). "

- *Food insecurity* — "Limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways. "

- *Hunger* — "*The* uneasy or painful sensation caused by a lack of food. The recurrent and involuntary lack of access to food. Hunger may produce malnutrition over time. ... Hunger ... is a potential, although not necessary, consequence of food insecurity."

These definitions underlie the CPS Food Security Supplement and the new measurement scale discussed below, with the one additional qualification, already described, that only resource-constrained or poverty-linked food insecurity and hunger are intended to be captured by the measure.

The Food Security Scale

The Food Security Supplement contains a large battery of questions asking respondents about various aspects of food sufficiency in their households. Taken individually, none of these questions can provide a measure of the severity and extent of food insecurity or hunger. Taken together, a systematic set of 18 of the CPS questions (those with strong statistical properties

identified by the measurement method) do provide such a measure. The CPS questions ask about five general types of household food conditions, events, or behaviors:

- Anxiety that the household food budget or food supply may be insufficient to meet basic needs;
- Perceptions that the food eaten by household members was inadequate in quality or quantity;
- Reported instances of reduced food intake, or consequences of reduced food intake (such as the physical sensation of hunger or reported weight loss) for adults in the household;
- Reported instances of reduced food intake or its consequences for children in the household; and
- Coping actions taken by the household to augment their food budget or food supply (such as borrowing from friends or family or getting food from emergency food pantries).

All of the CPS food security questions explicitly condition the event or behavior identified as being due to financial limitation (such as "... because we couldn't afford enough food" or "because there wasn't enough money to buy food. ") Each question addresses an explicit time frame, either the past 12 months or the past 30 days. Several key items include follow-up questions on how often the event or condition occurred within the past 12 months or the past 30 days.

Two separate measurement scales were developed, one for the severity of food insecurity within the 12-month period, the other for the 30-day period. The 12-month scale covers a broader range of severity levels of food insecurity and hunger, because fewer questions were asked in the 30-day time frame. The more comprehensive 12-month measure is expected to be the more useful, both for research and policy purposes, and is the focus of discussion in this report.

The scaling methodology began with exploratory linear and non-linear factor analyses to determine the number of distinct factors that should be represented. Scales were estimated using a Rasch measurement model, a form of non-linear factor analysis in the family of Item

Response Theory models.[1] Most food insecurity and hunger questions met the statistical criteria for inclusion in the models, although the resource augmentation questions did not. The final 12-month food security scale is based on answers to 18 questions, including some from each of the first four types of questions identified above.

Key findings during the scaling analysis were as follows:

- The results are consistent with previous research characterizing food insecurity as a "managed process" through several stages or levels of severity (Radimer et al., 1992). In this process, households first note serious inadequacy in their food supply, feel anxiety about the sufficiency of their food to meet basic needs, and make adjustments to their food budget and food served. As the situation becomes more severe, adults experience reduced food intake and hunger, but they spare the children this experience. In the third stage, children also suffer reduced food intake and hunger and adults' reductions in food intake are more dramatic.

  The severity ranking of questions in the measurement scale proceeds generally in this order. At the same time, it shows that all three stages fit well in a single scale, which means that the level of severity of food insecurity can be measured as an essentially unidimensional aspect of the food insecurity/hunger phenomenon.

- The measurement models were tested with three different population groups: households with children; those without children but with one or more elderly members (age 60 or older); and those with neither children nor elderly members. Tests showed that a single scale can be used with all three populations.

- An extensive series of tests found the food security scale to have good reliability, including good internal (or content) validity and good external (or construct) validity.

Defining Levels of Severity of Food Insecurity and Hunger

Four categories of food security status are defined, based on the distinct behavioral stages associated with the managed process of food insecurity and hunger:

- ***Food secure*** — Households show no or minimal evidence of food insecurity.

[1] IRT models are a form of statistical measurement model developed in educational testing, where test items vary systematically in difficulty and the overall score measures the level of difficulty that the tested individual has mastered. In the present application, the severity of food insecurity that the household has experienced is analogous to the level of test difficulty that an individual has mastered.

- ***Food insecure without hunger*** — Food insecurity is evident in households' concerns and in adjustments to household food management, including reduced quality of diets. Little or no reduction in household members' food intake is reported.

- ***Food insecure with moderate hunger*** — Food intake for adults in the household has been reduced to an extent that it implies that adults have repeatedly experienced the physical sensation of hunger. Such reductions are not observed at this stage for children in the household.

- ***Food insecure with severe hunger*** — Households with children have reduced the children's food intake to an extent that it implies that the children have experienced the physical sensation of hunger. Adults in households with and without children have repeatedly experienced more extensive reductions in food intake at this stage.

Each household is classified into one of the four food security status categories on the basis of its value on the food security scale; Exhibit ES-l illustrates the process. Households with zero scale score are those reporting no indications at all of food insufficiency or insecurity. Households with low scale values are those reporting very slight experiences of food insecurity. Both these groups are classified as food secure. At the other extreme, households with high scale values are those who report experiencing all or nearly all of the conditions covered by the scale, and are classified as food insecure with severe hunger. A household classified into a particular category must normally have experienced all of the conditions associated with the less-severe categories, plus at least two or three of the conditions associated with the assigned category.

The Prevalence of Food Insecurity and Hunger in the United States

The large majority of American households were food secure in the year ending April 1995. About 88.1 percent of the approximately 100 million households in the United States are classified as food secure over that period, as illustrated in Exhibit ES-2. About 11.9 million households, however, experienced food insecurity at some level during that year.

Most of the food insecure households are classified as food insecure without hunger (7.8 percent, or 7.8 million households). About 4.1 percent, however, are classified as food insecure with hunger. Thus, one or more adult members of some 4.2 million American households are estimated to have experienced reduced food intake and hunger as a result of financial constraints in the year ending in April 1995.

Exhibit ES-1

THE FOOD SECURITY STATUS CATEGORIES

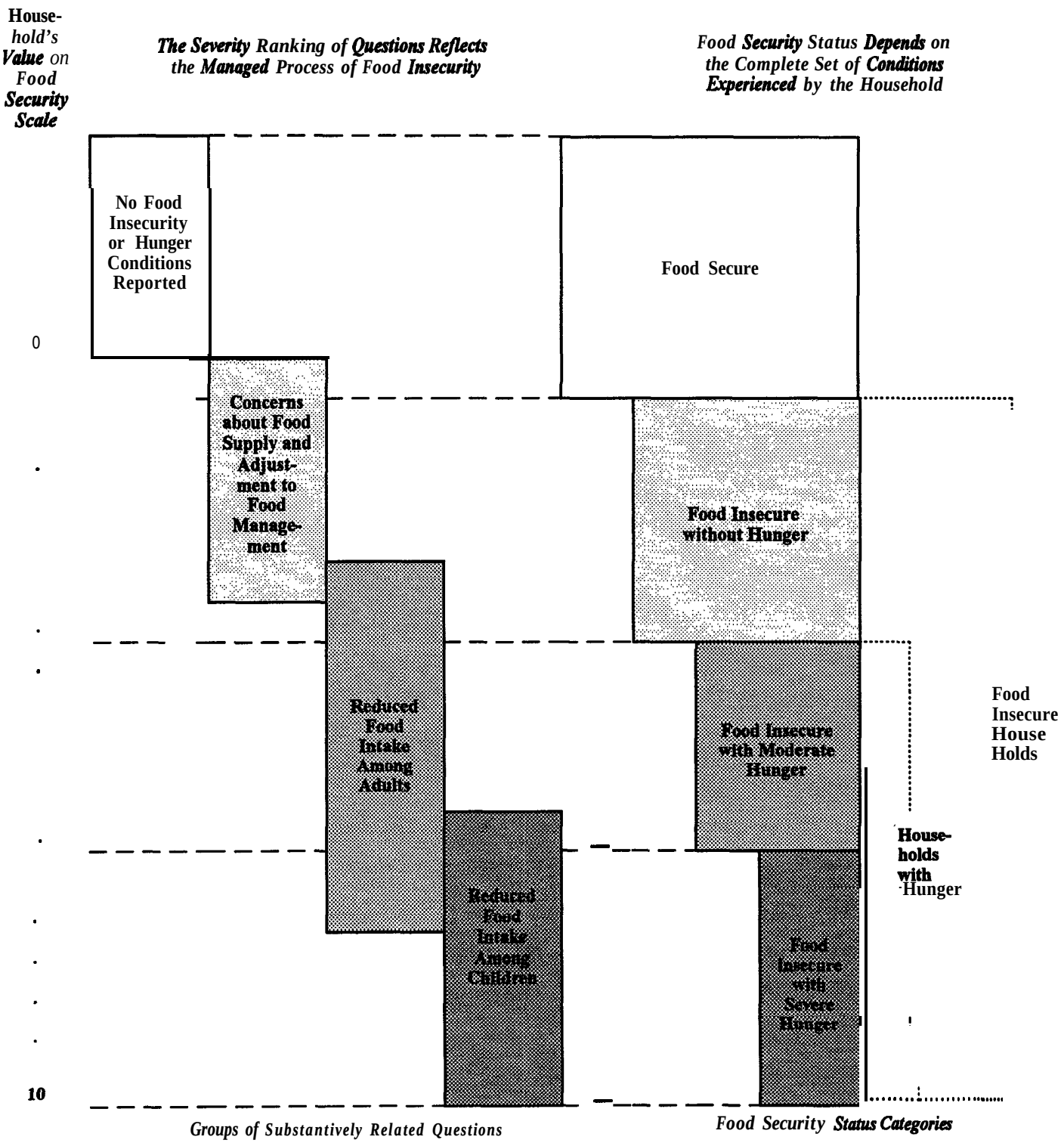
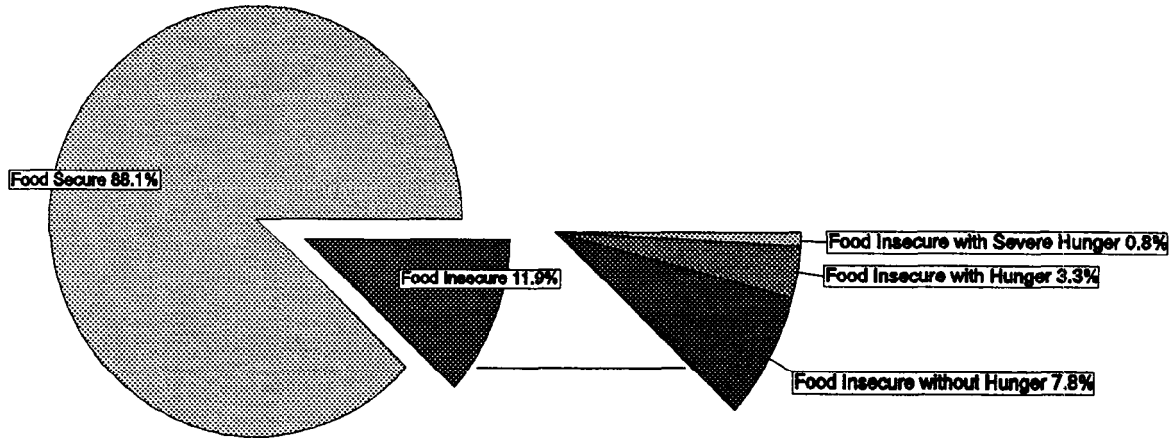


Exhibit ES-2

PREVALENCE OF FOOD SECURITY AND HUNGER, 1995



Among the households experiencing some level of hunger, about 800,000 (0.8 percent) are classified as food insecure with severe hunger. In these households, children as well as adults experienced reduced food intakes and hunger. Adults in these households had very substantial reductions in food intake, such as not eating for a whole day because of lack of money.

Food insecurity is clearly related to income and poverty, but the relationship is not exact. Not all poor households are food insecure, and only a small percentage of households with below-poverty incomes experience actual hunger (13.1 percent). The percent of households estimated to experience food insecurity is somewhat less than the poverty rate for individuals in the same period (12 percent *vs.* 15 percent). More than a third of poor households are classified as food insecure, whereas only 8 percent of households with above-poverty incomes are food insecure, and most of those have near-poverty incomes. Public and private food assistance programs may account for the fact that so many poor households are food secure, but this hypothesis has not yet been analyzed.

Even though food insecurity does not exactly follow income lines, food insecurity tends to be concentrated in population groups that have comparatively high poverty rates. For example, food insecurity rates are higher than average in female-headed households, in

households with children (especially young children), in Black and Hispanic households, and **in** central city areas.

Next **Steps**

The present analysis represents an important step in the measurement of food security, food insecurity, and hunger, but much more lies ahead for the food security measurement project. A task for the immediate future is to identify subsets of the questions in the CPS Food Security Supplement, and appropriate scaling procedures, so that smaller survey efforts can approximate the scale presented here with reasonable reliability. Another ongoing effort is to refine and strengthen the Food Security Supplement itself, so that the annual surveys planned for the future will yield comparable and increasingly reliable information. In the longer term, FCS and the larger research community will be undertaking several lines of data collection and analysis to understand better the phenomenon of food insecurity and to apply that understanding in the design and implementation of nutrition policies and food assistance programs.

CHAPTER ONE

FOOD SECURITY AND HUNGER MEASUREMENT IN THE UNITED STATES

Introduction

One of the basic aims of U.S. public policy in the latter half of the 20th century has been to assure that all Americans have enough to eat. The President's Task Force on Food Assistance stated the theme in its 1984 report:

> ***It has long been an article of faith among the American people that no one in a land so blessed with plenty should go hungry. ... Hunger is simply not acceptable in our society.*** — Task Force Report, p. 2

The commitment to reduce and ultimately eliminate poverty-linked hunger in the United States has been expressed in the allocation of public resources to major public programs of food assistance targeted to families and persons in need. Beginning in the 1960s, food assistance programs grew to be an important part of the general social safety net of government-aided programs aimed at reducing poverty. By 1996, some $35.6 billion of federal funds were devoted to food assistance to American families and single persons. Nevertheless, despite the amount of these resource transfers, either as direct emergency food aid or financial means to obtain food through normal channels of trade, food insecurity and hunger due to lack of adequate financial resources continues to be a problem for some Americans.

In order for the policies and programs aimed at reducing food insecurity and hunger to be directed effectively, it is important to be able to measure with some degree of confidence the conditions that the policies and programs are intended to affect. Lack of reliable measures with which to gauge their impact may hamper the effectiveness and appropriateness of the policies and programs themselves; at the least, lack of such measures leaves policymakers and the public in doubt as to the actual effect of food-assistance programs. The 1984 Task Force Report noted the lack, up to that time, of any authoritative measure of the number of people in the U.S.

experiencing poverty-related hunger, and the problem for policy making caused by this lack of a reliable hunger measure. [1]

Food Insecurity and Hunger Measurement-Background

In 1977, the federal government began collecting information on food sufficiency in American households through a single question included in the periodic national food consumption surveys conducted by the U.S. Department of Agriculture (USDA). In the 1980s, additional questions on food insecurity and hunger were included in the Third National Health and Nutrition Examination Survey (NHANES III) conducted by the Department of Health and Human Services, National Center for Health Statistics/Centers for Disease Control and Prevention.

The challenge implicit in the 1984 President's Task Force Report-to develop a valid and reliable measure of the severity and extent of hunger in the U.S. -was taken up most actively by scientists and researchers in the private sector, both in academia and under sponsorship by concerned social-policy and policy-research organizations. These private-sector efforts to develop and implement technically competent, scientifically grounded measurement of the conditions of food insecurity and hunger in the U.S. in the latter 1980s, demonstrated the feasibility of developing such measures.[2] This body of research and field survey experience produced methodologically sophisticated, empirically grounded measurement scales for food

[1] While we have found evidence of hunger in the sense that some people have difficulty obtaining adequate access to food, we have also found that it is at present impossible to estimate the extent of that hunger. We cannot report on any indicator that will tell us by how much hunger has gone up in recent years. .... Since general claims of widespread hunger can neither be positively refuted nor definitively proved, it seems likely that the issue of hunger will remain on our national policy agenda for an indefinite future. " (Task Force Report, Chapter 5: How Much Hunger is There in America?-Conclusion, p. 39.)

[2] Two major sustained research efforts in particular during this period provided the technical basis for the direct household-level measurement of food insecurity and hunger under working definitions relevant to the U.S. context. One is the work of Wehler and colleagues, beginning with the 1983 Massachusetts Nutrition Survey and continuing with the 1985 New Haven Risk Factor Study, the initial pilot study of the Community Childhood Hunger Identification Project, or CCHIP (Wehler, 1986; Wehler, Scott and Anderson, 1991, 1992, 1995a,b). The other is the work of Radimer and colleagues in the Cornell University Division of Nutritional Sciences, including Radimer's 1990 doctoral dissertation and subsequent work at Cornell to develop and extend this approach (Radimer, 1990; Radimer, Olson and Campbell, 1990; Campbell, 1991; Radimer et al., 1992; Kendall, Olson and Frongillo, 1995; Olson, Frongillo and Kendall, 1995). A third important contribution to this body of research, focusing on food insecurity and hunger as experienced by elderly persons, is Burt, 1993, and Cohen, Burt and Schulte, 1993.

insecurity and hunger in households lacking resources to obtain sufficient food, and demonstrated the practical means of creating such measures from reasonably obtainable social survey data.

During the same period, a consensus was emerging within the nutrition community over the appropriate conceptual basis for identifying and measuring U.S. hunger, viewing it as an element or consequence of a broader condition of food inadequacy associated with poverty and identified as "food insecurity." An important step in this direction had been taken by the President's Task Force in recognizing the distinction between clinical or medical definitions of hunger, on the one hand, and "hunger as commonly defined," on the other. Simply put, the medical definitions associate hunger closely with malnutrition, "a weakened, disordered condition brought about by prolonged lack of food" (Report, p.34), identifiable from clinical indicators such as weight loss in adults and serious underweight or stunting of growth in children. By the time hunger shows up in these clinical measures, however, the condition has persisted over a long period of time. The clinical definition and measures of hunger thus do not provide sensitive indicators of food insufficiency and hunger as these are primarily experienced in the U.S. context. Nor do they respond to the policy concern to address hunger and the risk factors for hunger-especially for children-as soon as these appear, rather than only after they have persisted for extended periods at substantial levels of severity.[3]

[3] In addressing "hunger as commonly defined," the *1984* President's Task Force helped clarify the shift from an exclusively medical definition of hunger to an alternative social definition more relevant to actual U.S. conditions. The discussion also anticipates the later attention to food insecurity, recognizing that a broader condition of food problem than hunger, as such, provides the context within which resource-constrained hunger is experienced:

> ***To many people hunger means not just symptoms that can be diagnosed by a physician, it bespeaks the existence of a social, not a medical, problem: a situation in which someone cannot obtain an adequate amount of food, even if the shortage is not prolonged enough to cause health problems, It is the experience of being unsatisfied, of not getting enough to eat. This, of course, is the sense in which people ordinarily use the word. It is also the sense in which the witnesses before us and many of the reports and documents we have studied have spoken of hunger. ... And in this sense, we cannot doubt that there is hunger in America. This is the sad truth. It is easy to think of examples of this kind of hunger: children who sometimes are sent to bed hungry because their parents find it impossible to provide for them; parents, especially mothers, who sometimes forgo food so that their families may eat; the homeless who must depend on the largess of charity or who are forced to scavenge for food or beg; and people who do not eat properly in order that they save money to pay rent, utilities, and other bills.*** (Report, p. 36)

Two events in 1990 mark the emergence of consensus on the appropriate concepts of food insecurity and hunger relevant for the U.S. First was sponsorship and publication by the American Institute of Nutrition (AIN) of a major report prepared by the Life Sciences Research Office (LSRO) of the Federation of American Societies for Experimental Biology, Core ***Indicators of Nutritional State for Difficult-to-Sample Populations*** (Anderson/LSRO, 1990). The AIN/LSRO report provides authoritative definitions of food security, food insecurity, and hunger as key areas for further development and measurement. These LSRO definitions provide the basic conceptual underpinnings for the present measurement project and guided the development of its measurement objectives.

The second event noting a coming of age of food security measurement was the passage by the U.S. Congress of the National Nutrition Monitoring and Related Research Act of 1990, mandating creation of a joint plan of action by USDA and DHHS for comprehensive nutritional monitoring of the U.S. population. Subsequently, the Ten-Year Comprehensive Plan for the National Nutrition Monitoring and Related Research Program (NNMRRP) included the task assignment to:

> ***Recommend a standardized mechanism and instrument(s) for defining and obtaining data on the prevalence of "food insecurity" or "food insufficiency" in the U.S. and methodologies that can be used across the NNMRRP and at State and local levels.***

Responsibility for carrying out the development of standardized measures of food insecurity and insufficiency for the U. S. is assigned under the Ten-Year Plan jointly to the Food and Consumer Service (FCS) of USDA and the National Center for Health Statistics/Centers for Disease Control and Prevention (NCHS) of DHHS. Beginning in 1992, FCS and NCHS established a federal interagency working group to carry out the assigned task, initiating the present food security measurement project. The present report represents the first major product resulting from this continuing development effort.

Food Insecurity and Hunger Measurement-Conceptual Basis

As noted, the 1990 AIN/LSRO report presents the nutrition community's understanding, gained from the research on food insecurity and hunger up to that time, and provides the conceptual basis for the present measurement project. The report defines food insecurity and

hunger in a way that clarifies the meaning of hunger, as directly experienced, spells out the relationship between food insecurity and hunger, and makes it possible to measure them both across the full range of severity of these conditions as they are experienced. Thus, the LSRO definitions of food insecurity and hunger are critical in helping define the measurement objectives of the present project. The conceptual definitions provided by the AIN/LSRO report are referred to herein as the LSRO definitions (Anderson/LSRO, 1990, p. 1598). They are:

> ***Food security — Access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e. g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).***
>
> ***Food insecurity — Limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.***
>
> ***Hunger — The uneasy or painful sensation caused by a lack of food. The recurrent and involuntary lack of access to food. Hunger may produce malnutrition over time. Hunger, as the recurrent and involuntary lack of access to food which may produce malnutrition over time, is discussed as food insecurity in this report.***
>
> ***Hunger, in its meaning of the uneasy or painful sensation caused by a lack of food, is in this definition a potential, although not necessary, consequence of food insecurity. Malnutrition is also a potential, although not necessary, consequence of food insecurity (Ibid.,*** p. 1576).

These conceptual definitions are consistent with the sequence of household food conditions and behaviors revealed in the earlier research on hunger measurement. The understanding of the phenomenon of food insecurity and hunger that they present recognizes the distinction between the medical and social definitions of hunger described in the President's Task Force Report, and clarifies the relationship of hunger to less severe conditions of food insufficiency. The LSRO definitions also reflect efforts to make scientific research findings from hunger and nutrition studies more relevant and useful in the public policy arena (Habicht and Meyers, 1991) and to reduce confusion arising from multiple definitions and interpretations of the term hunger.

In this perspective, hunger has the common meaning of a physical sensation that is familiar to everyone through direct personal experience. Poverty-linked hunger, the potential object of public policy concern, is distinguished from other hunger by its primary proximate cause. The hunger identified by this definition occurs as a consequence of food insecurity, nested within that broader poverty-linked concept.[4]

The LSRO definitions clarify the relationship between the concepts of food insecurity and hunger. Hunger is a "potential although not necessary consequence of food insecurity." Recognizing this relationship opened the possibility of measuring hunger and food insecurity together, by means of a single measurement scale. In such a scale, hunger would lie in the more severe part of the range. The less severe part of the range would capture more limited food insufficiency and some of the household coping behaviors that represent responses to food insufficiency.

This idea of a coherent underlying phenomenon, varying through distinct levels of severity and revealing an orderly sequence of characteristic conditions and behaviors, provides the basis for the current measurement effort. If a comprehensive set of indicators for the various aspects of food insufficiency and associated household coping responses are found to fall in a regular, orderly sequence from recognizably less severe to more severe conditions of inadequacy, then a scaled measure is both feasible and appropriate for gauging the severity and extent of the phenomenon.

Food insecurity and hunger may also be seen as one potential facet of poverty, as manifested in this particular area of basic need. Observing the distinct conditions and behaviors that characterize food insecurity reveals the kind of economizing and coping efforts that households make in trying to manage their available resources when these are insufficient to fully cover basic needs. The identification and measurement of food insecurity and hunger may thus help provide better understanding of poverty in general. Moreover, if the observed

[4] The terminology and concept of food security and food insecurity, which originally referred to issues of community-wide food supply in lower-income countries, were found useful in describing issues of household-level food sufficiency and access in the U.S. as well. During the same period, the international literature on food security in low-income countries was also beginning to apply the concept to the household level, as a feasible and sensitive early warning indicator for potential or approaching food sufficiency problems in the general population or population subgroups. (See, e.g., Daniel G. Maxwell, ***Measuring Food Insecurity: The Frequency and Severity of "Coping Strategies,"*** Washington, DC: International Food Policy Research Institute, Discussion Paper #8, December 1995.)

indicators of food insecurity are surveyed and measured consistently over time, then the regular national measurement of food insecurity and hunger can provide an important supplement to the established measures of income poverty as a tool for monitoring changes over time in the well-being of the population, and differences across population subgroups.

The Hypothesis of Hunger as Severe Food Insecurity

The idea of an orderly, normal sequence of behaviors as households strive to cope with increasingly insufficient food resources, represents a central working hypothesis of the present hunger measurement project. In summary, the hypothesis is that hunger may be seen as a consequence of persistent or worsening food insecurity, appearing when the condition reaches sufficiently severe levels. Hunger is viewed as nested within the broader concept and experience of household food insecurity, and food insecurity results from an immediate lack of household income or other financial resources.

When they experience food insecurity due to limited or reduced resources, household food managers, usually mothers or female heads of household, may attempt to deal with an insufficient household food supply through a variety of coping behaviors and strategies. This management of the conditions of food insecurity may include attempts to augment household food from irregular or emergency sources, and may involve reductions in the quality and/or quantity of food available within the household. Moreover, this managed process occurs within the context of tightly constrained economic choices, likely to involve uncertainty as to future availability of adequate food. Consequently, it is identifiable in part by characteristic affective states, such as anxiety or worry about whether food or money will last, or whether more can be obtained before food supplies run out.

Under this hypothesis, if household food sufficiency declines further, efforts to manage the process eventually require reductions in food intake among one or more household members. Reduced food intake is likely to occur initially via reduced serving sizes, reduced overall meal sixes, or skipped meals. These behaviors will provide the first indication that actual hunger, "the uneasy or painful sensation caused by a lack of food," is being experienced by household members as part of the effort to manage an insufficient household food supply. In households with children, reduction of food intake is expected to occur **first** among adults, as they attempt to spare the children from food intake reduction.

If efforts to cope with an intensifying degree of food insecurity are not successful, reductions in food intake and hunger will also occur among children in the household. When children's hunger occurs it may be viewed as indicating a more severe condition, partly because the consequences of hunger are likely to be more damaging for children than adults, and partly because adults in the household normally will have experienced hunger for some period of time prior to the children. If household hunger persists or recurs often enough, observable signs of malnutrition will appear among either the adults or children in the household, or both (Radimer, Olson and Campbell, 1990; Radimer *et al.,* 1992; Wehler, Scott and Anderson, 1992). Before such clinical signs of malnutrition become evident, however, the quantity and nutritional quality of diets in food-insecure households will necessarily have been deficient for some extended period of time.

The central hypothesis that food insecurity and hunger represent a coherent range of conditions and experience, that these are different and distinct from the nutritional quality of diets, and that they can be directly observed and measured, is put to the test by the attempt to develop a measure that is based on the hypothesis. Other implications of the hypothesis, however, are not addressed by the measurement itself. For example, the expected relationship between food insecurity and hunger as measured in this study and the nutritional quality of diets as measured by nutritionists can be tested only after the food security measure is available for comparison with established nutritional measures. If the food insecurity and hunger measure is found to be closely correlated with dietary quality, food insecurity and hunger measures may prove useful as simple indirect indicators of the nutritional adequacy of diets. It will be important for future research to explore the exact nature of the interrelationships among poverty-linked food insecurity, hunger, and malnutrition.[5]

The Role of Food Security Measurement

Reliable measures of food insecurity and hunger and consistent estimates of their prevalence in the population can meet the needs of policymakers in designing and directing effective policies and programs to address these conditions. Although considerable progress

[5] Several research studies have demonstrated the link between food insufficiency as experienced and nutritional inadequacy of diets. A recent example is D. Rose and V. Oliveira, "Nutrient Intakes of Individuals from Food Insufficient Households in the United States," *American Journal of Public Health* (forthcoming).

occurred during the past decade in developing technically sound, scientifically-grounded methods to measure food insecurity and hunger, accurate national measures from which consistent prevalence estimates could be derived have not been available. Inclusion of the goal to develop such measures in the ten-year comprehensive plan for the **NNMRRP** reflected the widely-held view within both the social policy and scientific communities of the importance of the food security of the nation's population. As a result, designing a survey instrument for collecting national data on food security and applying state-of-the-art measurement methods to create reliable and consistent national benchmark measures was identified as an explicit objective of national policy.

Accurate measurement of these conditions on a consistent basis from year to year is expected to provide a valuable tool for administrators and policymakers at several levels, state and local as well as national. Such measures can help identify those segments of the population most in need, assess the impacts of changing economic conditions and public programs on this basic element of well-being, and monitor the success of efforts to reduce poverty-linked hunger over time. For these uses, the most important aspect of the measures is their degree of reliability and consistency: the measures should provide the ability to track year-to-year changes in food insecurity and hunger at several specified, well-defined levels of severity, and provide a reliable set of standard national benchmark measures for consistent application and comparison with equivalent state and local measures.

From the standpoint of sound measurement method, the foremost concern is that the measures of food insecurity and hunger that are developed yield valid and reliable descriptive statements about the existence and extent of the phenomenon. The food security measurement project cannot determine the causes of food insecurity, nor whether its existence is a serious social problem requiring a policy response. Those judgments will be made by policymakers, advocates, and the general public. Results from the consistent and reliable measurement of food security can, however, be expected to help inform and strengthen those judgements. In the remainder of this chapter, we summarize some of the considerations contributing to incorporation of food security measurement into the national policy agenda.

Child and Adult Health Considerations. Economically, a well-prepared work force is essential to America's success in the rapidly changing global economy. Sound physical and mental health are key factors in providing the skilled, well-educated workers demanded by

increasingly technical service-oriented domestic labor markets. Good nutrition throughout the life cycle, but especially during childhood, is a necessary prerequisite for successful physiological and cognitive development and maintenance of sound health (Munro, Suter and Russell, 1987; Duncan, Brooks-Gunn and Klebanov, 1994; Pollitt, 1994; Frazão, 1995; Kretchmer, Beard and Carlson, 1996).

Evidence from recent research in child development indicates that school performance, cumulative educational achievement, and mastery of skills are affected both by physiological factors related to adequate nutrient intake and by factors related to food security and sufficiency of food intake (Pollitt, 1994). In addition to detrimental effects on physical growth and cognitive development resulting from chronic or severe undernutrition, serious cumulative deficits also accompany chronic lack of access to adequate food (Pollitt, Leibel and Greenfield, 1981; Meyers et *al.*, 1989). Simple hunger—"the uneasy or painful sensation caused by a lack of food"-can interfere with a variety of behaviors necessary to successful learning—e.g., concentration, ability to maintain the focus of one's attention, achievement motivation, and inclination toward physical activity.

Young children especially need frequent intake of nutritionally adequate food to maintain food energy stores needed for effective activity. A child's small liver size relative to total body mass limits its capacity to store sufficient glycogen for ready conversion to energy over extended time periods. Therefore, children need to eat more frequently and regularly than adults to maintain needed levels of available energy. Moreover, most nutrient requirements increase dramatically during periods of rapid growth, further amplifying the importance of adequate nutritious food for overall healthy growth and development.

The concept of "sentinel groups," as applied to disease and nutrition surveillance systems, is prominent in public health. Sentinel groups can be predictive of future events or conditions, and are often selected for monitoring as a result. Such groups have characteristics that make them likely to be the first in the population to contract a disease or suffer from malnutrition (Anderson/LSRO, 1990, pp. 1574-1575). Knowledge of changes in conditions among sentinel groups can often enable policymakers and health officials to implement responses that help avoid widespread occurrence of more costly diseases or conditions. Food-insecure households may comprise a sentinel group in which hunger, undernutrition, and poor health are

more likely to occur (Munro, Suter and Russell, 1987; Wehler, Scott and Anderson, 1992; Pollitt, 1994; Frazão, 1995; Wehler, Scott and Anderson, 1995a,b).

Several surveys included in the NNMRRP provide information on food intake and undernutrition. The emergence of nutrient deficiencies over time, however, implies that households in which affected individuals reside are likely to have experienced what is now understood to be a progression through worsening levels of food insecurity. In this view, hunger and undernutrition are understood to occur at the more severe levels of food insecurity, whereas serious nutrient deficiencies are likely to occur only after chronic food insecurity with hunger has been experienced. The progressive and nested nature of hunger and undernutrition within food insecurity thus make measures that identify the entire range of food insecurity valuable as sensitive leading indicators for more serious health consequences. Thus, accurate and reliable measures of food insecurity at its various levels of severity will provide valuable information for informing and guiding national and state policies.

Conclusion

The new CPS food security data, and the standard measurement method for severity and extent of food insecurity based on the data, are expected to provide useful resources for research into the causes and consequences of food insecurity and hunger. The subject area of food security poses challenges and opportunities for researchers, particularly because of the overlap between public health and nutrition concerns, on the one hand, and concerns of general poverty policy, on the other. The food security measures provide new information relevant to both these fields, and to the relationship between them. The utility of the new data and measurement for research, however, is only a secondary reason for obtaining them. The primary purpose is to provide a broad new assessment and monitoring tool for policymakers and administrators of government food assistance programs at all levels.

Chapters Two through Four of this report describe the operational measurement concepts, survey questionnaire design, food security data collected, and the analytic procedures used in developing a measurement scale. Chapter Five presents the initial prevalence estimates for food insecurity and hunger in the United States resulting from the new measure. Chapter *Six* discusses the reliability and limitations of the measure.

More detailed explanation and documentation of the methods used in developing the food security measure are presented in the companion volume to the present report (Hamilton ***et al.*, 1997).**

CHAPTER TWO

THE FOOD SECURITY SUPPLEMENT TO THE CURRENT POPULATION SURVEY

This chapter briefly describes the development of the Food Security Supplement questionnaire and the subsequent data collection effort undertaken for USDA by the U. S. Bureau of the Census as a part of the Current Population Survey (CPS) for April 1995. The chapter includes a short description of the 1994 Food Security Measurement and Research Conference that preceded development of the national-level food security questionnaire for use in the CPS. The fiil survey instrument that emerged from this conference and the subsequent development process is described, as are the basic CPS sample and the Food Security Supplement subsample.

The Food Security Measurement and Research Conference

The Food Security Supplement instrument is based upon a synthesis of tested material reported from earlier research. Initial consensus on the content of the instrument for national use was attained during the January 1994 Food Security Measurement and Research Conference convened jointly by FCS and the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention. The conference was attended by nearly 100 professionals with direct experience in areas related to nutrition, health, economics of food consumption, food security policy, and hunger measurement. This working conference included presentations by the authors of the primary research related to food insecurity and hunger measurement over the previous decade.[1] The second half of the conference was devoted to identifying a consensus (with the aid of professional facilitators) among participants regarding the optimal content and form of a food security survey instrument for application at the national level.

Several key issues that had been insufficiently addressed by earlier work needed to be clarified before the LSRO conceptual definitions could be adapted for national data collection. The resolution of these issues by FCS, conference participants, and a federal interagency

[1] Transcripts of the presentations and discussion from this conference, with background papers and participant list, were published in a volume entitled "Food Security Measurement and Research Conference: Papers and Proceedings, " USDA FCS, Office of Analysis and Evaluation, June 1995).

working group on food security measurement, led to the measurement approach implemented in the current study.[2] The key issues were:

- How to treat aspects of food insecurity that are not necessarily caused by a lack of adequate household income, but are relevant for households at all. income levels (e.g., food safety concerns). The decision was to limit the current measure to clearly poverty-linked or resource-constrained food insecurity and hunger.

- Whether to limit operational definitions to only those aspects of food security that can be captured in household-level surveys. It was agreed that the FCS effort should limit its measurement approach to the household. It was noted that agencies involved in collecting individual-level data might develop complementary approaches for measuring food insecurity at the specific individual level, whereas issues of community food security would require a different data collection strategy and orientation, outside the scope of the present effort.

- Whether indicators of nutritional adequacy would be incorporated into the operational definition and measurement of food security. The decision was to focus on the behavioral and experiential dimensions of food insecurity and hunger, which were seen as the major gap in existing information and an essential component for policymakers.

- How to estimate the prevalence of food insecurity and hunger from the resulting data. Participants agreed on the desirability of scaling items into a single measure across all observed levels of severity of the phenomenon being measured, if feasible, and to develop a standard set of prevalence estimates at several designated levels of severity for consistent application and comparison across data sets from year to year.

During the year following the Food Security Measurement and Research Conference, the national survey questionnaire underwent extensive further development, testing, and refinement. Participants in the conference working sessions and the federal interagency working group continued their contributions to this work, along with survey method specialists from the Census Bureau's Center for Survey Methods Research (CSMR). The revised survey instrument resulting from this development process was field-tested by the Census Bureau in August 1994 with approximately 600 regular CPS sample households. These field test results were analyzed

[2] The measurement approach and its background in the research literature are described in Bickel, Andrews and Klein, 1996. Participants in the Federal Interagency Working Group on Food Security Measurement are listed in Appendix G.

by **CSMR,** and the instrument was further refined to incorporate a number of subsequent **CSMR** recommendations.

The fiil version of the food security questionnaire was administered by the Census Bureau as a supplement to its regular April 1995 CPS. In its final form, the questionnaire contained 58 items intended to identify three levels of severity of food insecurity, including two levels involving hunger on both a **12-month** and a **30-day** basis.

Questions in the Food Security Supplement

The questions in the food security questionnaire can be grouped into eight subject areas, as summarized in Exhibit 2-l. The items in Part I are included primarily for the purpose of helping validate the food security and hunger measures developed. Items in Part II are included for assessing program impacts on food insecurity and hunger. Questions in Parts III-VIII were designed to reflect the full observed range of severity of U.S. household food insecurity and hunger, and to provide potential indicator items for inclusion in scale development analyses.

Two additional dimensions are embodied in the candidate scale items in Parts III-VIII of Exhibit 2-l. All questions are asked of an adult respondent, usually the household member with greatest knowledge of the household's food shopping and consumption, and relate generally to the household unit as a whole. Some questions ask specifically about conditions or circumstances of the respondent, others ask about the adults generally in the household, and some ask about the children generally (in households where children are present). Thus, items can be classified as "Household," "Adult," or "Child" items.

In a second important distinction, all questions relate to one of two separate time frames: the past 12 months or the past 30 days. Some **12-month** items are followed by subsequent items asking how often, or in how many months, a condition occurred during the past 12 months. Similarly, several 30-day questions have follow-up items asking how often, or in how many days, a condition occurred during the previous **30** days. A few questions form four-item sequences following the pattern: (i) "did it ever occur within the past 12 months?," (ii) "if so, in how many months did it occur?," (iii) "did it occur within the past 30 days?, " and (iv) "if so, on how many days did it occur?"

Both the adult-child and time dimensions of **the** items are conceptually related to aspects of the hypothesized managed process of household efforts to cope with food insufficiency, as

Exhibit 2-l

SUMMARY OF FOOD SECURITY SURVEY ITEMS BY SUBJECT AREA

Description of Survey Item Part	Items in Each Part
Part I: Weekly household food expenditures by place of purchase	(Eight items) Q1 - Q8
Part II: Food assistance program participation by type of program	(Eight items) Q9, Q9A - Q9G
Part III: USDA and NHANES-III food sufficiency items, and follow-up	(Four items) Q11A, Qll, Q12, Q13
Part IV: Existence of conditions requiring food-insufficiency coping behaviors	(Three items) Q15 - Q17
Part V: Household food-supply-augmentation coping behaviors	(*Six* items) Q18 - Q23
Part VI: Adult food intake reduction items	(15 items) Q24 - Q39
Part VIZ: Child food intake reduction items	(13 items) Q40 - Q52, Q57
Part VIII: Radimer-scale food sufficiency items (adult and child food quality and quantity concerns)	(Six items) Q53 - Q58

described in Chapter One. Research evidence had shown that when hunger emerges in food-insecure households it usually appears first among adult members, affecting children only at more severe levels.[3] Thus, items addressing aspects of food-intake suffkiency for adults and for children separately can provide a basis for measuring household food insecurity across differing levels of severity.

Several types of periodicity have been observed in studies of household food insufficiency and hunger.[4] Food insecurity at the less severe levels is expected to be more chronic in nature and less subject to this periodicity. For example, concerns about the adequacy of household food supplies may persist for some time after a household experiences inadequate

[3] Radimer, 1990; Radimer *et al.,* 1992; Wehler, Scott and Anderson, 1992; Olson, Frongillo and Kendall, 1995.

[4] See, for example, transcriptions of presentations by John Cook, Valerie Tarasuk, and Janet Fitchen included in "Food Security Measurement and Research Conference: Papers and Proceedings," USDA FCS, June 1995.

food supplies. Hunger is a more acute condition, however, and in the U.S. context is more likely to occur only periodically within households. For example, hunger may occur at the end of month, when household food resources are depleted, but then subside after paychecks, food stamps, or transfer payments are received. The two time periods addressed by survey items *(12* months and 30 days) and follow-up items regarding frequency of occurrence are designed to capture some part of this periodic aspect of food insecurity.

The Current Population Survey Sample

The Food Security Supplement was first fielded as a part of the April 1995 CPS. The CPS is a nationally-representative monthly survey conducted by the Bureau of the Census in approximately 58,000 households throughout the U.S. The CPS is a probability sample based on a stratified sampling design. The overall sample is selected from lists of housing unit addresses obtained from the most recent decennial census, and updated for new construction.[5]

The CPS sample is a state-based design, with primary sampling units (PSUs), consisting of counties or groups of counties, selected in an initial sampling stage. The PSUs are grouped into strata, with all strata defined within state boundaries. The sample is allocated among the states to produce both state and national estimates with the required reliability, while keeping total sample size to a minimum.[6] Each stratum consists of one or more PSUs, with one PSU chosen for the sample from within each stratum with probability proportional to its population as of the most recent decennial census.

In a second step, a sample of addresses is obtained within each sample PSU. Most addresses are selected from census lists in a single stage within the selected PSU, although for a relatively small proportion a second stage of selection is necessary. This two-step process is roughly equivalent to a simple sampling plan of dividing each state into ultimate sampling units

[5] This brief summary of the CPS sample is based on documentation provided to users of the CPS public use data tapes. For more detail, see the U.S. Department of Labor, Bureau of Labor Statistics, "Redesign of the Sample for the Current Population Survey," ***Employment and Earnings*** 41(5): *7-10,* May 1994.

[6] The magnitude of standard errors of state-level estimates produced from CPS data are related to the size of each state's population. Therefore, estimates for states with large populations will be more reliable and stable over time than those for states with smaller populations. In general, state-level estimates for the ten to twelve states with largest populations are fairly stable, whereas those for the other states may vary considerably from year to year due to greater sampling error and larger standard errors.

(USUs), each containing about four neighboring housing units, and selecting cluster samples of these USUs for the interview.

The variables used for stratification within each state derive from the principal uses of the CPS in providing reliable data for estimating labor force participation and characteristics. The same stratification variables are used in all states, and include employment and unemployment statistics by male, female, and total population; employment by occupation; change in population; racial and ethnic composition of population; and other variables.

Each CPS sample is divided into eight approximately equal rotation groups, with each group interviewed for four consecutive months, dropped out for eight months, then brought back in for four more consecutive months before being permanently retired. This "four months in—eight months out-four months in" rotation leads to improved reliability of estimates of month-to-month and year-to-year changes.

The weights for all interviewed households in the CPS sample are adjusted to account for occupied households for which no information could be obtained. Some reasons for non-interview include absence, impassable roads, refusals, or unavailability for other reasons. If a respondent is reluctant to participate in the CPS, the interviewer informs the regional office staff, and a follow-up letter is sent to the household with a fuller explanation of the CPS. If this procedure fails to achieve participation, a supervisory field representative recontacts the household and attempts to obtain participation through efforts to accommodate the respondent's concerns. The CPS non-interview rates range around 5-6 percent monthly.

The CPS Food Security Supplement Sample

Approximately 53,700 households completed the April 1995 basic CPS questionnaire, and were invited to answer the Food Security Supplement. Of these, 44,730 households completed the supplement, implying a non-interview rate of 16.7 percent below the basic CPS sample. The respondents completing the supplement included households at all income levels, both above and below the federal poverty thresholds. Special weights were computed to adjust the final supplement sample for the demographic characteristics of supplement non-interviews.

The Food Security Screener. The complete Food Security Supplement instrument was administered to all households with incomes at or below 185 percent of the federal poverty level for the 12 months prior to their entry into the CP sample. This is the income-poverty threshold

used in determining eligibility for some federal assistance programs (e.g., WIC and reduced-price school lunch and breakfast programs). All households with incomes below this level received all parts of the questionnaire.

Preliminary analyses of NHANES-III data had indicated that some households with annual incomes above 185 percent of poverty may have experienced food insufficiency sometime during the period covered by that survey (1988-94), based on their responses to food sufficiency items included in the NHANES questionnaire. To reduce the risk of screening out any currently food-insecure households with prior-year annual incomes above 185 percent of poverty, three additional routes for passing through the screener were included for higher-income households. These were: (1) reporting sometimes or often not having enough to eat on either of the two versions of the food sufficiency question (Q11 A, or Q11 and 412); (2) a combined answer pattern indicating the possibility of (low-severity) food insecurity (Q15 - "did you ever run short of money and try to make your food or food money go further?" plus reporting "enough but not the kinds of food wanted" in Q11A or 412); and (3) an affirmative answer to Q16 - "did you ever run out of the foods that you needed to make a meal and didn't have money to get more?"

Of the 44,730 households that completed the Food Security Supplement, a total of 18,453 households passed this screener and were asked the full battery of food security and hunger questions. This group comprised the preliminary analysis sample for developing the food security scale. These included 15,662 households with incomes below 185 percent of poverty and 2,791 households with higher incomes. Initial analyses determined that an additional 83 households lacked responses on some important items, and these were dropped from the sample. This created a final analysis sample of 18,370 households used in the development of the measurement scales for food insecurity and hunger.

To allow assessment of reliability of the measurement scales and their invariance across different household types, the analysis sample was randomly subdivided into four subsamples. Initial scale development analyses and modeling were implemented using one of these subsamples, with the remaining three preserved for use in reliability and invariance testing. The Food Security Supplement sample is shown by household type in Exhibit 2-2.

Exhibit 2-2

DESCRIPTION OF THE FINAL FOOD SECURITY SUPPLEMENT SAMPLE BY TYPE OF HOUSEHOLD

	Household Type		
	Households with Children	**Households with Elderly and No Children**	**Households with No Elderly or Children**
Number of households in the population	38,232,774	27,851,187	34,354,945
Proportion of households in the population	38.1%	27.7%	34.2%
Number of households in the sample (total: 44,730)[a]	16,954	12,503	15,273
Proportion of households in the total sample	37.9%	28.0%	34.1%
Number of sample households passing the screener (total: 18.453)	7,998	5,731	4,724
Proportion of sample households passing the screener	43.3%	31.1%	25.6%

[a] Households completing the survey. Of those respondents completing the Supplement, 83 provided incomplete information on food security items and were dropped from the final analysis sample.

CHAPTER THREE
THE FOOD SECURITY MEASUREMENT SCALE

The questions included in the CPS Food Security Supplement were designed to represent the full range of severity of food insecurity and hunger as experienced in U.S. households, in order to allow the development of a comprehensive food security measurement scale, The purpose of such a scale is to combine a household's answers to many survey' questions into a single measure of the severity of food insecurity and hunger, where the household's score on the measurement scale indicates the level of severity of food insecurity it has experienced. This chapter describes the two scales that have been developed. One measures the full range of food insecurity and hunger on a 12-month basis; the other focuses on only the more severe conditions of reduced food intake and hunger measured on a 30-day basis.

Scale Development

The process of developing, refining, and testing the scales occupied nearly a year, from the autumn of 1995 through the summer of 1996. The methods used and results obtained are summarized briefly below and described more fully in the study's technical report (Hamilton et *al.,* 1997).

Each of the questions considered as candidates for the food security scale refers explicitly to either the 12-month or the 30-day time frame. After early descriptive and exploratory analyses, these two groups of questions were separated, and distinct models were estimated for the 12-month and 30-day periods. The procedures described below apply generally to both the 12-month and the 30-day models, although the 12-month scale will be the main focus of the following discussion.'

Linear Analysis. Exploratory analyses were first conducted using linear factor analysis methods. This analysis phase was principally devoted to replicating analyses reported in the existing literature to determine whether the findings of prior research were applicable to the national population-level CPS data. These analyses focused on households with children, which

[1] The companion Technical Report volume provides a description of the 30-day scale and presents estimates of the prevalence of hunger within the 30-day period.

were asked all questions in the Food Security Supplement. Results showed general conformity with previous research. Analyses suggested that either a one- or two-factor model would best fit the data in linear models.

Exploratory Non-linear Analysis. Because most questions in the Food Security Supplement are asked in dichotomous or categorical form, a non-linear factor analysis model was considered best suited to the structure of the data. Exploratory analyses were conducted, fitting a series of alternative models to determine whether a single- or multi-factor model would best fit the data. Results indicated the unidimensional model to be most appropriate. Thus, the results support the hypothesis that the severity of food insecurity and hunger can be validly viewed as a single continuous dimension, along which various aspects of household food sufficiency and food management behaviors are arrayed.

Preliminary Model Estimation. The statistical approach chosen was the Rasch model, a concise one-factor non-linear Item Response Theory (IRT) model that was fit to the CPS data using a specialized software package.[2] Using a one-fourth random subset of the CPS data, a preliminary model was fit for the subpopulation of households with children within that one-quarter sample. The model was refined iteratively. Fit statistics were examined for each question in the candidate set, items that failed to meet threshold criteria were discarded, and the model was re-estimated with the new candidate list.

Tests for Invariance. The model estimated for households with children was then estimated separately for two other groups: households without children but with one or more elderly members, and households with neither children nor elderly members. A high level of correspondence was found among the models fit to the three separate household types, indicating that food security and hunger could be measured for all three populations using the same scale. A single model was therefore estimated for the full sample population, combining all three household types.

Tests for Robustness. The preliminary model estimated with the one-fourth subsample was then fit to the remaining three one-fourth partitions of the sample. Essentially identical

[2] IRT describes a general type of measurement model developed by the educational testing industry for use in developing and scaling tests such as aptitude tests. IRT models provide a way to measure the overall ability level of an individual being tested, based on widely varying difficulty of particular questions, and on the individual's overall pattern of response to the entire set of questions.

results were found for all subsamples, which indicates that the model should be stable across repeated samples of households. The model was therefore re-estimated from the entire CPS sample.

Tests for Reliability. A variety of statistical tests for reliability were performed, including tests specific to the Rasch model and several tests commonly used for scales developed through linear analyses. Tests indicated quite good reliability for the 12-month scale and moderate reliability for the 30-day scale (Hamilton *et al.*, 1997).

12-Month and 30-Day Scales

Although food security measurement scales were developed for both the 12-month and 30-day time frames, this report gives primary emphasis to the 12-month scale, which is considered the more broadly useful measure.

The difference between questions asked in the 30-day time frame and the parallel 12-month questions is solely a matter of calendar timing. The 12-month questions ask whether the household experienced a particular condition at any time during the year ending in April 1995, whereas the 30-day questions ask whether those conditions that were experienced during the year also were experienced during the 30-day period prior to the survey.[3] The questions do not differ in the severity of the condition they measure, but because of this difference in time periods, one would expect to find more positive responses to the 12-month questions than to their parallel 30-day versions, and the data bear out this expectation.

The questions included in the 12-month scale differ substantively from those in the 30-day scale in one important respect. A number of questions about less severe food insecurity conditions (for example, whether the respondent worried that the household would run out of food before getting money to buy more) were asked in the 12-month time frame but not the 30-day frame. The 12-month scale is therefore able to describe a broader range of food insecurity conditions. This makes the 12-month scale better suited to a number of policy and research purposes, and also gives it stronger statistical properties.

[3] More precisely, the questions refer to the time -period ending on the day of the interview, which occurred during the period April 16-22, 1995.

The remainder of this volume accordingly focuses mainly on the 12-month scale. As noted above, details on the 30-day scale are presented in this study's technical report.

Questions Used in the Scale

All 12-month questions in the Food Security Supplement were tested for possible inclusion in the scale.[4] Most candidate questions met the statistical criteria for inclusion in the final version of the model. Exhibit 3-l lists the questions that are included, showing them in the order in which they appear in the questionnaire.

The questions included in the scale capture four kinds of situations or events. All are related to the general definition of food insecurity presented earlier, which includes a psychological dimension as well as qualitative and quantitative aspects of food supply and food intake. The four kinds of situation are:

- Anxiety or perception that the household food budget or food supply was inadequate (453, Q54)
- Perceptions that the food eaten by adults or children was inadequate in quality or quantity (Q32, Q55, Q56, Q57, Q58)
- Reported instances of reduced food intake, or consequences of reduced intake (such as feelings of hunger or reported weight loss) for adults in the household (Q24, Q28, Q35, Q38)
- Reported instances of reduced food intake, or its consequences, for children (Q40, Q43, Q47, Q50)

A number of the questions in the CPS Supplement did not fit the 12-month model, and are therefore not included in the measurement scale. Three of the excluded questions indicate relatively less severe conditions of food insecurity, such as concerns about the adequacy of the

[4] Specifically, those considered were the 12-month questions in the series from Q15 through Q58 (see Appendix A). The response frequencies for the 12-month and 30-day questions in this sequence are shown in Appendix B.

Exhibit 3-l

QUESTIONS INCLUDED IN THE FOOD SECURITY SCALE

Question Number	Question
24, 25	In the last 12 months, did you or other adults in your household ever cut ***the size of your meals or ship meals*** because there wasn't enough money for food? How often did this happen-almost every month, some months but not every month, or in only 1 or 2 months?
28, 29	In the last 12 months, did you or other adults in your household ever not ***eat for a whole day*** because there wasn't enough money for food? How often did this happen-almost every month, some months but not every month, or in only 1 or 2 months?
32	In the last 12 months, did you ever ***eat*** less ***than you felt you should*** because there wasn't enough money to buy food?
35	In the last 12 months, were you ever ***hungry but didn't eat*** because you couldn't afford enough food?
38	Sometimes people lose weight because they don't have enough to eat. In the last 12 months, did you ***lose weight*** because there wasn't enough food?
40[a]	In the last 12 months, did you ever ***cut the size of any of the children's meals*** because there wasn't enough money for food?
43[a], 44[a]	In the last 12 months, did any of the ***children ever ship a meal*** because there wasn't enough money for food? How often did this happen-almost every month, some months but not every month, or in only 1 or 2 months?
47[a]	In the last 12 months, were the ***children ever hungry*** but you just couldn't afford more food?
50[a]	In the last 12 months, did any of the ***children ever not eat for a whole day*** because there wasn't enough money for food?
53	"I ***worried whether our food would run out*** before we got money to buy more." Was that often, sometimes, or never true for you in the last 12 months?
54	"The ***food fhaf we bought just didn't last***, and we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months?
55	"We ***couldn't afford to eat balanced meals."*** Was that often, sometimes, or never true for you in the last 12 months?
56[a]	"We ***couldn't feed the children a balanced meal*** because we couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months?
57[a]	"The ***children were not eating enough*** because we just couldn't afford enough food." Was that often, sometimes, or never true for you in the last 12 months?
58[a]	"We ***relied on only a few hinds of low-cost food to feed the children*** because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months?

[a] **Question asked only of households with children.**

food budget or food supply, or adjustments to the type of food served.' Although these particular questions were excluded, this range of comparatively less severe food insecurity experience is captured by other questions that did meet the statistical goodness-of-fit criteria for inclusion in the model.

The other five excluded questions ask about actions that a household might take to cope with food insecurity by seeking external food resources (examples are borrowing food or money for food from friends or relatives, or getting meals at soup kitchens).[6] These "resource augmentation" questions have a peculiar relationship to food insecurity. On the one hand, they represent household responses to a situation of food insecurity, and thus provide conceptually valid indicators of the existence of the condition: households that are food secure are not expected to take such actions. On the other hand, a household that successfully augments its food resources may thereby become less food insecure, so these indicators do not fit well in scales measuring the severity of the condition. Probably because of the complicated nature of their relationship to food insecurity, the resource augmentation or coping questions did not meet the statistical criteria for inclusion in the food security measurement model.

All questions are entered in the models in dichotomous "yes/no" form. Three follow-up questions in the 12-month series ask whether a situation occurred "almost every month, some months but not every month, or in only 1 or 2 months." These questions were recoded to combine the first two response categories into "three or more months."[7] Questions 53-58 ask the respondent whether the condition was "often, sometimes, or never" true in the past 12 months. The first two of these response categories are combined into "sometimes or often."

[5] These were Q15 ("Did you ever run short of money and try to make your food or your food money go further?"); Q16 ("Did you ever run out of the foods that you needed to make a meal and didn't have money to get more?"); and Q20 ("Did you ever serve only a few kinds of low-cost foods-like rice, beans, macaroni products, bread or potatoes-for several days in a row because you couldn't afford anything else?").

[6] The specific questions *are* Q18 (get or borrow food from friends or relatives); Q19 (children eat at home of friends or relatives); Q21 (put off paying bills); Q22 (get food from church or food pantry); and Q23 (get meals at soup kitchen).

[7] The other category, "less than three months," is coded to include respondents that answered negatively to the base question.

Relative Severity of Questions in the Scale

The analytic software that estimates the measurement scale computes an "item calibration" value for each question included in the scale. The item calibration score indicates the relative severity of the food insecurity or hunger condition represented by each question.* Exhibit 3-2 illustrates the pattern of relative question severity. Questions representing less severe levels of food insecurity and hunger are located at the bottom of the chart, and those measuring more severe levels are at the top. Questions that are grouped closely together can be considered to represent approximately the same level of severity of food insecurity and hunger.

The pattern of question severity reflects the three progressive stages of food insecurity that previous research has found for households with children. The first stage involves adjustments to the overall household food budget and to patterns of food acquisition and use. In the second stage, adults reduce food intake while generally protecting the children's intake levels. ***The*** third stage involves reductions in food intake for children as well as more pronounced reductions for adults.

The item calibration scores generally correspond to this pattern. The least severe questions reflect concerns about the food supply and adjustments to the kind and quality (but not the amount) of food eaten. The most severe questions indicate reduction of children's food intake or drastic reductions in adult intake (not eating for a whole day). In between lie the questions indicating reductions in adult food intake.

Some overlap in item calibration scores, or severity, exists in the groups of questions. For example, the least severe child-oriented questions in the scale **(Q58** and **Q56)** occur quite early in the severity sequence, whereas the most severe adult-oriented question **(Q29)** occurs at quite an advanced point in the sequence. This suggests that the movement between stages does not occur as abrupt or uniform behavior shifts, but as graduated adjustments that are likely to differ from household to household.

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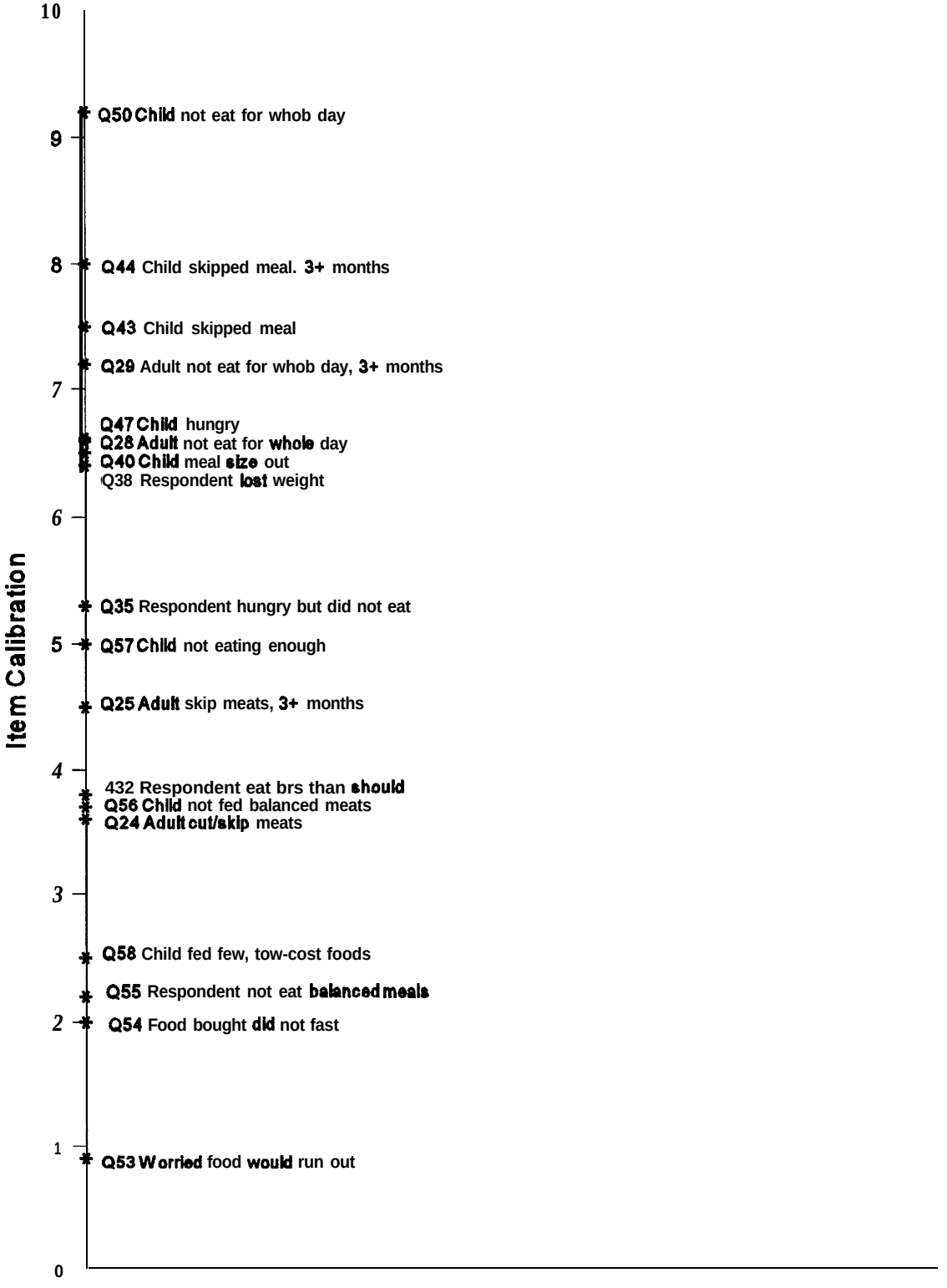
8 In educational testing, the item calibration is considered to describe the relative difficulty of questions in a test. The item calibration score for a particular question depends on the overall response pattern by all the persons initially taking the test (i.e., when the "test is calibrated") and is based on the probability that households with a given value (overall test score) on the scale answer the question affirmatively. Households with scale value equal to the item calibration are predicted to have a 50 percent chance of answering the question affirmatively.

Exhibit 3-2

SEVERITY RANKING OF QUESTIONS IN FOOD SECURITY SCALE



Note: ttem caiibratbns show relative severity of questions from 0.9 (least severe) to 9.2 (most severe).

Household Values on the Scale

The scaling model also assigns to each household a value on the scale. The household value is based on the number of questions the respondent answers affiiatively, adjusted for the number and relative severity of the questions the respondent answers.[9] Among households that answer the same set of questions, those that give more affirmatives have higher values on the scale.

The analysis indicates that household response patterns are largely ordered. That is, a household that answers a particular question affirmatively tends to affirm all less severe questions as well. It is appropriate to characterize households with *n* affirmative responses as having affirmed the *n* least severe questions, because that is the single most common, or modal, pattern.[10]

The vast majority of households have the lowest possible value on the scale (a scale score of zero), indicating that they did not respond affirmatively to any food insecurity or hunger questions. Many of these households were screened out because their incomes were above 185 percent of the poverty level and they gave no indication of food insecurity in the preliminary screener questions; such households amount to about 40 percent of all respondents. Another large group of households passed the screen and were asked all food insecurity questions, but responded negatively to all of them.

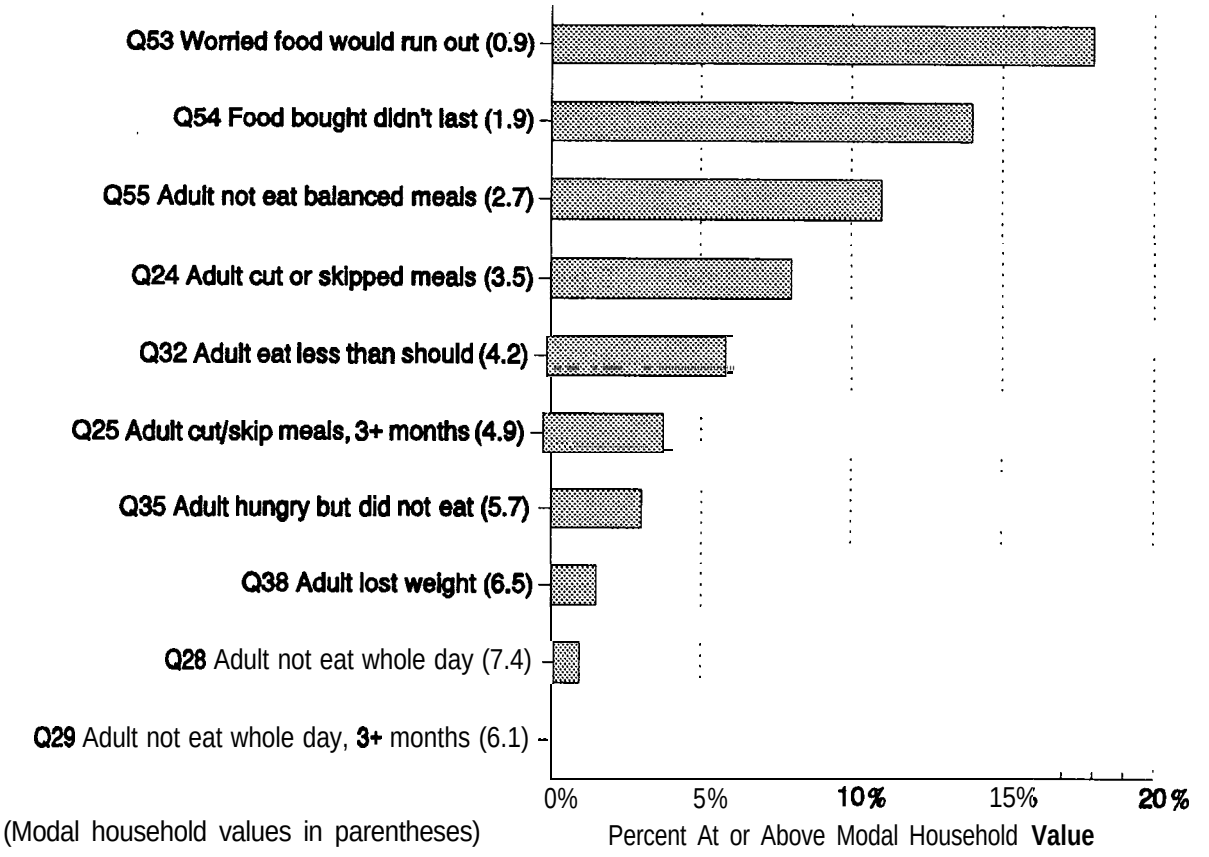
Thus, 82 percent of all households surveyed had the lowest possible value on the scale. The other 18 percent answered at least one question affirmatively and therefore have values above the minimum. The proportion of households at each successively greater level of severity declines rapidly, as indicated in Exhibit **3-3. The** exhibit shows the percentage of the sample with household values at or above selected levels. The selected levels are the modal household values associated with each non-child question in the scale-that is, each question that is

[9] The adjustment is necessary because all respondents do not answer all questions. Eight of the 18 questions in the 12-month scale are asked only to households with children. In addition, a few respondents simply fail to respond to some of the questions they are asked.

[10] Most households follow the modal pattern in their responses to the scaled questions, but not all households do. For example, a household with *n* affirmative responses may answer negatively to one of the less severe questions (i.e., less severe than the nth question), but answer affirmatively to one of the more severe questions. Such a household would have the same value on the scale as a household following the modal pattern. Households without children whose responses exactly follow the modal pattern amount to 82 percent of all households without children in the sample.

Exhibit 3-3

POPULATION DISTRIBUTION BY SELECTED HOUSEHOLD SCALE VALUES



applicable to all households with or without children. For each question in sequence, the modal household value is the scale value assigned to all those households that said "yes" to that specified question and to all less severe questions, but that said "no" to all the more severe questions. The chart can thus be read as indicating the percent of households that answered affirmatively to the specified question and to all less severe questions.

About 18 percent of the sample households have scale values above the minimum, as indicated in the top bar on the chart. Only 8 percent have scale values at or above the level corresponding to the first direct indicator of reduced food intake (Q24). Just 0.1 percent have scale values in the highest range shown on the chart, associated with adults repeatedly not eating for a whole day (Q29).

Overview of Scale Development Results

In summary, the food security scale has three key properties. First, it captures multiple facets of food insecurity within the single dimension of relative severity, an important exception being resource augmentation actions that households take to address food insecurity. [11] Resource augmentation aside, the analysis indicates that food insecurity and hunger can be viewed as a unidimensional phenomenon that increases in severity from essentially no food insecurity up through the most severe level measured in the U.S. context. [12]

Second, the relative severity of the questions that make up the scale conforms well with past research. The severity ranking is quite consistent with the concept of food insecurity and hunger as a managed process, going through distinct behavioral stages that first involve the household budget and food use patterns, then the reduction of adult food intake, and finally reductions in the food intake of children in the household.

Finally, a relatively small proportion of survey respondents is seen to have any measurable level of food insecurity or hunger. This is the expected result in a survey representing the entire U. S. population. The proportion diminishes rapidly at higher, more severe levels of the scale.

[11] Other dimensions of food insecurity included in the LSRO conceptual definition, such as nutritional inadequacy of diets, problematic food safety, and food access problems apart from the household's own resource limitations, are not intended to be captured in the present measurement of food insecurity.

[12] A measurement scale developed for use in economically less-developed countries would be expected to include conditions more severe than those incorporated here, such as severe malnutrition and starvation.

CHAPTER FOUR
THE FOOD SECURITY STATUS MEASURE

The analysis reported in Chapter Three supports the hypothesis that food insecurity and hunger can be viewed as an ordered, sequential phenomenon. Households are distributed along a range that runs from no indication of food insecurity at all, through increasing levels of severity, up to the most severe measured level of food insecurity and hunger. Households in the United States are very largely food secure, falling outside the measured range of food insecurity and hunger. Among the minority of U.S. households that are measurably food insecure, most are concentrated at the less severe end of the continuum, with only a small fraction at the most severe end.

It is useful for policy purposes to divide the population into groups that can be identified as experiencing different designated levels of severity of food insecurity. This entails subdividing the food security scale into separate ranges, so that a household's value on the scale classifies the household as falling in a particular severity level or category of food insecurity. A number of research efforts have categorized their study populations into two or three groups, such as food secure vs. food insecure (Burt, 1993), or not hungry, at risk of hunger, and hungry (Wehler, Scott and Anderson, 1992).

Four categories are defined in the present analysis, based on the differing behavioral patterns that characterize different broad ranges of severity of food insecurity and hunger. Previous research as well as the analysis reported here suggests that food insecurity manifests at the household level as a managed process of efforts to cope with inadequate supplies of food and resources to obtain food (Radimer, Olson, and Campbell, 1990; Basiotis, 1992; Radimer et *al.*, 1992; Wehler, Scott and Anderson, 1992; Burt, 1993; Cohen, Burt, and Schulte, 1993). This managed process moves through an observable set of stages as food insecurity increases. In the first stage, household members experience food insufficiency and anxiety about their food situation, and adjust their budget and food management patterns. For example, they may worry that their food will not last until they have money to buy more, they may substitute increasingly cheaper foods in their diet, and they may eat the same few low-cost foods several days in a row. In the second stage, adults reduce their food intake, but in households with children they ration

food to avoid reducing the children's food intake. Adults may be hungry, but normally they try to protect their children from being hungry. In the third stage, the children also experience a reduction in food intake and hunger, and adults' food intake is more sharply reduced (e.g., going an entire day with no food). The transition from one stage or broad range of food insecurity to the next may be a gradual alteration of conditions and behaviors, or may be more sharply demarcated, but in either case, it is likely to occur differently in different households. Nonetheless, it appears that, overall, distinct behavior patterns exist at different levels of food insecurity and hunger.

These observed behavioral patterns provide the foundation for defining the four categories of food insecurity used in the present measurement project.[1] In order of increasing severity of food insecurity, they are as follows:

- ***Food secure*** — Households show no or minimal evidence of food insecurity.[2]
- ***Food insecure without hunger*** — Food insecurity is evident in households' concerns and in adjustments to household food management, including reductions in diet quality, but with no or limited reductions in quantity of food intake. In terms of the LSRO definitions, households cannot predictably obtain access to an adequate quantity and/or quality of acceptable food, but household members are not evidently experiencing hunger due to resource scarcity.
- ***Food insecure with moderate hunger*** — Food intake for adults in the household is reduced to an extent that implies that adults are experiencing hunger due to lack of resources.

[1] This four-way categorization is applied only to the 12-month food security scale. Because the 30-day scale does not measure the less severe condition of food insecurity short of actual hunger, a three-way categorization is used for that scale: (1) no hunger evident; (2) food insecure with moderate hunger; and (3) food insecure with severe hunger. The conceptual and operational definitions of the latter two categories are parallel to those for the two most severe categories on the 12-month scale.

[2] Most U.S. households show no signs of food insecurity, based on consistently negative responses to several broad screener questions in the CPS questionnaire. Households in this category, and with prior-year annual incomes over 185 percent of poverty, were screened out of the remainder of the Supplement at that point and directly classified as food-secure without further analysis. A much smaller proportion of higher-income households passed through the food security screener, by virtue of positive answers to at least one of the screener questions. Most of these households were also subsequently classified as food-secure, based on further analysis. Some of this latter group of food-secure households show one, or at most two, additional positive indications of food insecurity in the CPS data. To be classified as food-insecure, however, a household had to show at least three positive indicators of food insecurity from the set of food security items beyond the screener questions.

- *Food insecure with severe hunger* — Households with children reduce the children's food intake to an extent that implies that the children experience hunger as a result of inadequate household resources. Adults in households with or without children experience extensive reductions in food intake (e.g., going whole days without food).

It is important to emphasize that these behavioral classifications do not imply policy judgments. Policymakers, advocates, and the public at large must decide whether and at what level food insecurity and hunger may constitute a social problem that merits public concern and government action.

Readers should also note the necessary role of judgment involved in giving exact operational definition to these categories. The particular categories specified for classifying households according to level of severity of food insecurity are grounded in observable patterns of behavior, and the placement of boundary lines between categories attempts to reveal the nature of these patterns as clearly as possible, given the content of the available data. The exact placement of the classification boundaries, however, necessarily involves interpretive judgment. Judgment is involved in determining how well each indicator item in the data corresponds to one or another of the designated ranges of severity described above. In addition, judgment is required in identifying or selecting the particular indicator that best represents the dividing line or transition from one designated severity range to the next. Reasonable people can disagree about whether the dividing lines between the several designated severity ranges should be located somewhat differently.

The most important uses of the food insecurity and hunger measures, however, will be in examining changing severity and extent of needs over time, or differing needs across population groups. Comparing the prevalence of food insecurity from one year to the next and across population groups on a consistent basis can help identify changing levels and location of need, and help inform decisions as to whether re-targeting of assistance may be needed. In such analyses, the key requirement is that the dividing lines be robust, defined in an operationally clear and consistent way over time and across subgroups. The emphasis of the analysis has therefore been on establishing a clear and replicable logic for defining categories, rather than seeking universal agreement on the appropriateness of each dividing line between categories.

Defining Ranges on the Food Security Scale

To classify households into the categories described above, the food-security measurement scale is subdivided into corresponding ranges. The general procedure for defining these ranges is summarized below. Subsequent sections review the logic for each of the specific ranges.

The definition of ranges takes advantage of the scaling model's estimates of the relative severity of the questions that make up the food security scale. Because the model indicates that responses are sufficiently well ordered, it is acceptable to assume that a household answering a particular question affirmatively also answers all less severe questions affirmatively. This is the predominant actual pattern, or pattern of the "modal households." This allows behavioral ranges on the food security scale to be identified by considering the substantive content of sets of adjacent questions. Thus, if all the questions prior to question ***n*** in level of severity are judged to reflect conditions of food insecurity but not hunger, whereas question ***n*** is deemed to be an indicator of actual hunger, the boundary between food insecurity without hunger and food insecurity with hunger can be set between question n-I and question ***n*** in the severity ranking. Question ***n*** itself would then be considered a threshold or boundary indicator for the more severe category of food insecurity with **hunger**.[3]

Although the discussion below focuses on the individual questions that border the boundaries between ranges of the scale, it is important to bear in mind that households are classified on the basis of their overall pattern of responses to the entire sequence of questions making up the measurement scale. No single question, no single condition is used to classify households. Rather, classification depends on the accumulated evidence, from the entire set of questions, that the household has (or has not) experienced a series of successively more severe conditions and behaviors.

[3] Technically, the boundary is established at a particular value on the scale. Once a boundary question is chosen, the boundary is set at the scale score of those modal households that answer all less-severe questions and the selected boundary question affirmatively, while answering all more-severe questions negatively. In the simplest case, if question ***n*** in the severity ranking is the boundary question and all households respond to the same total number of questions, the boundary is established at the scale value of households that answer exactly ***n*** questions affirmatively.

Food Insecure

> ***Food security — Access by all people at all times to enough food for an active, healthy life.. .. Food insecurity exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain.*** — Anderson/LSRO, 1990, pp. 1575-1576

The above definitions suggest that households are food insecure if they do not have, or cannot be reasonably sure of having enough food, of acceptable quality, to meet basic needs. Most questions in the Food Security Supplement, including all of the items retained in constructing the measurement scale, are pertinent to this concept of food insecurity.[4] A few questions measure either the respondent's level of uncertainty about the future adequacy of the household's food supply, or the retrospective assessment of the food supply.[5] A larger number of questions ask about events or conditions that can result from an inadequate food supply, such as not eating balanced meals, cutting or skipping meals, or losing weight because of not having enough food. All questions explicitly mention resource constraint as the immediate cause of food insufficiency through phrases such as "because you didn't have enough money."

Food insecure households are defined operationally as those which, at a minimum, express concerns about the adequacy of the household food supply and report some adjustments to dietary intake. Exhibit 4-l illustrates this criterion. The two least severe questions in the 12-month scale concern the households' food supply, asking whether household members "worried that our food would run out" or whether the "food that we bought just didn't last" (Q53 and 454). The third question in the severity ranking asks about the failure to eat balanced meals, an adjustment to nutritional (and conventional) quality of household members' diets (Q55). A respondent who answers all three of these questions affirmatively is deemed to show sufficient evidence of food insecurity to have met unambiguously the operational criterion for that

[4] The definition also refers to the household's need for access to food through "socially acceptable ways." This dimension of the definition may be captured in the CPS data with questions about coping activities such as getting emergency food from food pantries or eating meals at soup kitchens. As explained above (p. 26), however, these items are not included in the measurement scale for severity of food insecurity. (See the technical report for further discussion of the food-augmenting coping-behavior questions.)

[5] For example, Q53 asks whether respondents "worried our food would run out before we got more." Q54 asks whether "the food that we bought just didn't last, and we didn't have money to get more."

classification.[6] The boundary between "food secure" and "food insecure without hunger" is therefore drawn between Q54 and Q55 in the scale sequence.

Exhibit 4-l illustrates the application of this definition. Households that answer no questions affirmatively, or that affirm only the one or two least severe questions, are classified as food secure. Households that give affiative answers to three or more questions are placed into one of the three categories of food insecurity. The least severe condition classified as food insecure is that represented by affiiative answers to the three least severe questions in the scale sequence.

Food Insecure with Moderate Hunger

> ***Hunger — The uneasy or painful sensation caused by lack of food. The recurrent and involuntary lack of access to food ... a potential, although not necessary, consequence of food*** *insecurity*.[7] — Anderson/LSRO, 1990, p. 1598, 1576

As the severity of food insecurity increases, the household reaches a point at which further economizing on food costs requires reduction in food intakes such that household members experience hunger as a consequence of the household's financial resource limitation. Hunger, as the term is used here, is a physical sensation caused by a lack of food, where that lack of food results from scarce or limited household financial resources. The exact level at which the lack of food is certain to produce hunger varies substantially among individuals. The physiological literature indicates that virtually any noticeable reduction from an individual's

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[6] This minimum requirement of three affirmative responses is more stringent than most previous literature, which typically has classified households as food insecure if they respond affirmatively to any one or more food insecurity indicator questions, Research has shown that households answering as few as one of the questions positively have significantly reduced household food supplies, and that women in these households have reduced intakes of fruits and vegetables and increased body mass indices (Kendall, Olson and Frongillo, 1995).

The approach to range definition used here sets each boundary at a level that requires two or three affirmative responses to questions measuring the condition of interest. This strategy reduces the likelihood that a household will be placed in a too-severe category of food insecurity because of an erroneous affirmative response (a "false positive" classification). The trade-off is an increased likelihood that a household will be placed into a less severe category than actually merited (a "false negative" identification).

[7] The present project makes explicit the condition that the measurement objective is limited to hunger resulting from inadequate resources.

Exhibit 4-1

SEVERITY RANGES ON THE FOOD SECURITY SCALE

Questions Associated with Each Food Security 'Status Level

Sequence of Questions Answered Affirmatively by Modal Households[a]		Food Security Status
	None	Food Secure[b]
Q53	Worried food would run out	
Q54	Food bought didn't last	
Q55	Adult not eat balanced meals	Food Insecure[c]
Q58	Child fed few low-cost foods	
Q24	Adult cut size or skipped meals	
Q56	Couldn't feed child balanced meals	
Q32	Adult eat less than felt they should	
Q25	Adult cut size or skipped meals, 3+ months	
Q57	Child not eating enough	
Q35	Adult hungry but didn't eat	
Q38	Respondent lost weight	
Q40	Cut size of child's meals	
Q28	Adult not eat whole day	Food Insecure with Severe Hunger Evident[c]
Q47	Child hungry	
Q29	Adult not eat whole day, 3+ months	
Q43	Child skipped meal	
Q44	Child skipped meal, 3+ months	
Q50	Child not eat for whole day	

a Modal households are those showing a perfectly ordered response pattern, i.e., whatever the most severe question the household answered affitively, it also answers all less severe questions affitively. This is the predominant response pattern among survey households.

b Households with no affitive responses, or with one or two affirmatives, are classified as food secure. Some of these households may represent a "false negative" classification that under a methodologically less stringent classification rule would be identified as food insecure.

c To be classified in a given food security category, modal households must respond affirmatively to all questions associated with less severe categories, plus one or more of the questions associated with the category into which the household is classified. Other households (Le., those not fitting the exact modal pattern) must give the same total number of affirmative responses as the modal households.

normal level of intake can produce the physical sensation of hunger, although the sensation apparently occurs differently for different people, and different people describe it differently. [8] The definition of the range of food insecurity with hunger therefore focuses mainly on behavioral questions that ask about reductions in food intake, initially for adults and subsequently for children.

Several questions used in the scale explicitly measure situations in which adults in the household experience reduced food intake as a result of inadequate resources. Two others ask about potential consequences of reduced food intake, one question referring to the sensation of hunger and another asking about weight loss. In order of increasing severity, the questions are:

- Q24 cut or skip meals because there wasn't enough money for food
- Q32 eat less than you felt you should because there wasn't enough money to buy food
- Q25 cut or skip meals because there wasn't enough money for food, in three or more months
- Q35 hungry but didn't eat because you couldn't afford enough food
- Q38 lost weight because there wasn't enough food
- Q28 not eat for a whole day because there wasn't enough money for food
- Q29 not eat for a whole day because there wasn't enough money for food, in three or more months

The questions that ask about cutting or skipping meals and not eating for a whole day are asked with reference to "you or other adults in your household." The other questions are asked only about "you," the adult respondent.

The questions pertinent to reduced food intake by adults are generally concentrated in the middle of the overall severity ranking for food insecurity, but overlap with both the less severe food insecurity questions and the more severe questions indicating reduced food intake by children. The threshold question used in drawing the boundary between food insecure

[8] This literature is summarized in the companion Technical Report volume, Appendix A. See especially, among the references cited therein, Lappalainen ***et al.,*** 1990, Mattes and Friedman, 1993; and Read, French and Cunningham, 1994.

without hunger and food insecure with moderate hunger is Q25, which identifies a recurrent pattern of cutting or skipping of meals by adults in the household. Because this is the third question in the sequence asking about reductions in adults' food intake, and because it indicates multiple instances of reduced intake, it is deemed that households that reach this level on the scale have at least one, and potentially more, adult members who have experienced resource-constrained hunger. Thus, households that report repeated reductions in adults' food intake, in combination with affirmative responses to all less severe questions, are classified as food insecure with moderate hunger (see Exhibit 4-l).

Food Insecure with Severe Hunger

The most severe range of food insecurity measured by the scale is characterized by reduced food intake and consequent hunger for children. Most of the questions that pertain to reduced food intake and hunger among children are similar to questions asked about adults. They are listed below in order of increasing severity.

- Q57 children were not eating enough because couldn't afford enough food
- Q40 cut the size of children's meals because there wasn't enough money for food
- Q47 children were hungry but couldn't afford more food
- Q43 children skipped meals because there wasn't enough money for food
- Q44 children skipped meals, in three or more months
- Q50 children did not eat for a whole day because there wasn't enough money for food

The least severe of these questions (457) falls roughly in the middle of the range of questions shown earlier for adults. The remaining questions are all more severe than any adult-oriented item except the one measuring adults not eating for a whole day. Adults not eating for a whole day (428) has nearly the same severity as children being hungry (Q47).[9]

[9] Q28 and Q47 have item calibrations of 6.4 and 6.5, respectively. See Exhibit 3-2.

The intent in defining the most severe category of food insecurity is to focus on the condition of children. Specifically, the selected boundary item in the children's series is the question that asks whether the "children were ever hungry but you just couldn't afford more food" (447).

The classification procedure, however, must apply equally to households with and without children. A straightforward way to accomplish this objective is to select as the threshold item an adult-oriented question that is similar in severity to 447. Accordingly, the question about adults not eating for a whole day (Q28), which has almost the same item calibration score as the question about children being hungry, is used as the boundary question. Households, both those with and without children, that report that one or more adults did not eat for a whole day, and that respond affirmatively to all less severe questions, are classified as food. insecure with severe hunger.

Response Profile of Households in the Four Categories

If all survey responses were perfectly ordered, all households would fit the modal pattern that, although predominant in the actual data, is not universal. With perfectly-ordered data, we would expect to see very clear-cut differences between the response patterns of households classified into the different food security categories. For instance, 1.00 percent of the households categorized as food insecure without hunger would answer affirmatively either the three, four, five, six, or seven least-severe questions. No one in that category would give affirmative answers to any of the more severe questions in the scale (the eleven questions from Q25 onwards), because those questions lie beyond the boundary for the next more severe category, food insecurity with moderate hunger. For the five questions within the severity-range category of food insecure without hunger (Q55-Q32), the more severe questions would have systematically fewer positive responses than the less severe questions.

All of these patterns can be seen as general tendencies in Exhibit 4-2, although the divisions are not absolute because not all the survey responses are perfectly ordered. For example, among households classified as food insecure without hunger, more than 70 percent responded positively to all of the three least severe questions, whereas fewer than ***20*** percent responded positively to any one of the eleven most severe items, and less than 5 percent responded positively, on average, to these eleven severe items. The percent of positive

Exhibit 4-2

RESPONSE PROFILE BY CATEGORY

(percentage of Households in Each Food Security Category Answering Each Question Affirmatively)

Questions (in order of increasing severity)		Food Security Status			
		Food Secure[a]	Food Insecure, without Hunger[b]	Food Insecure, with Moderate Hunger[c]	Food Insecure, with Severe Hunger[d]
Q53	Worried food would run out	5.0	89.5	97.2	99.1
Q54	Food bought didn't last	2.3	80.9	98.1	99.4
Q55	Adult not eat balanced meals	1.9	75.4	94.9	98.5
Q58	Child fed few low-cost foods	2.3	63.4	91.0	100.0
Q24	Adult cut size or skipped meals	0.4	36.8	93.1	99.1
Q56	Couldn't feed child balanced meals	0.3	41.2	77.4	95.5
Q32	Adult eat less than felt they should	0.3	34.4	90.3	98.8
Q25	Adult cut size or skipped meals, 3+ months	0.1	20.0	77.2	94.6
Q57	Child not eating enough	0.1	15.5	53.5	96.2
Q35	Adult hungry but didn't eat	0.1	8.3	57.5	94.3
Q38	Adult lost weight	0.0	2.8	30.5	71.7
Q40	Cut size of child's meals	0.0	2.1	24.2	70.7
Q28	Adult not eat whole day	0.0	2.4	20.7	87.6
Q47	Child hungry	0.0	1.7	20.0	72.9
Q29	Adult not eat whole day, 3+ months	0.0	0.8	11.6	80.6
Q43	Child skipped meal	0.0	0.6	8.1	56.4
Q44	Child skipped meal, 3+ months	0.0	0.2	4.7	43.6
Q50	Child not eat for whole day	0.0	0.1	1.4	18.1
Number of households in sample (unweighted)[e]		39,736	3,254	1,326	331

a No or minimal indicators of food insecurity evident.

b Multiple indicators of food insecurity, but no or minimal indicators of resource-constrained hunger evident for household members.

c Multiple indicators of resource-constrained hunger evident for adult household members.

d Multiple indicators of resource-constrained hunger evident for children in household and/or indicators of severe adult hunger.

e For questions applicable only to households with children, the unweighted sample in the four groups is: 14.192, 1,934, 655, and 133.

responses to each item consistently increases from left to right across the table, reflecting increasing levels of food insecurity; within each food insecurity category, the percent of positive responses declines from top to bottom, as the severity level of the questions increases.

Relationship of Food Security Status to Other Measures

Food insecurity is, by definition, a result of constrained financial resources. One would therefore expect income to be related to food security status. At the same time, one would not expect the correlation to be perfect for several reasons. In particular, in-kind food assistance programs, which are designed to ameliorate food insecurity, are specifically targeted to households with low income. Thus, food insecurity should depend on income in combination with other factors that ameliorate the effect of low income, especially program participation.

In fact, food security is clearly related to income, as shown in Exhibit 4-3.[10] Among households whose income is less than half of the federal poverty level, 41 percent are classified as having experienced some kind of food insecurity in the past 12 months," and 5 percent fall into the most severe category of food insecurity. In contrast, 96 percent of the households with annual incomes above 185 percent of the poverty level are classified as food secure. [12]

Food security status is also related to the level of household expenditures for food. Households reporting that they usually spend less than $20 per household member per week are much more likely to be classified as food insecure than those spending $40 per week or more (21 percent vs. 6 percent).

Finally, the food insecurity categories defmed here show close links to the food sufficiency measure that has been used in much previous research. Of the respondents who say in the food sufficiency measure that they have "enough of the kinds of food we want to eat, "

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[10] Income is measured in this analysis as cash income, exclusive of in-kind food assistance. Including the cash value of such assistance might lead to a stronger relationship between income and food security.

[11] This includes all households classified into any of the three food insecurity categories-i.e., those in the three right-hand columns of Exhibit 4-3.

[12] Because annual income and food security status are not measured for precisely the same period, it is possible for a household with apparently substantial income to be accurately identified as food insecure. In fact, it would be possible even if the two constructs were measured for exactly the same 12-month period. For example, a head of household could have substantial earnings for the first nine months of the year and then lose his or her job. Such a household might well be food insecure in the last months of the year.

Exhibit 4-3

RELATIONSHIP OF THE FOOD SECURITY STATUS MEASURE TO OTHER VARIABLES

	Households in Sample	Food Security Status[a]			
		Food Secure	Food Insecure without Hunger	Food Insecure with Moderate Hunger	Food Insecure with Severe Hunger
Income Relative to Poverty Line[b]					
< 50%	2,219	59.5%	***24.2%***	***11.4%***	***4.9%***
so-100%	4,431	69.6	20.1	8.2	1.9
101-185%	8,944	82.6	11.9	4.6	0.9
> 185%	29,053	96.2	2.6	1.0	0.2
Weekly Food Expenditures per Household					
< $20	***7,681***	***79.2***	13.9	5.6	1.4
$20-29	10,291	88.0	8.6	2.9	0.6
$30-39	8,406	92.4	5.3	2.0	0.3
$40 or more	14,826	93.7	4.0	1.9	0.5
Food Sufficiency[c]					
Enough of the kinds of food we want to eat	4,432	95.9	3.4	0.6	0.1
Enough but not always the kinds of food we want to eat	879	63.6	25.9	9.4	1.0
Sometimes not enough to eat	124	21.8	31.5	36.3	10.5
Often not enough to eat	38	15.8	29.0	18.4	36.8

[a] See notes, Exhibit 4-2.

[b] Income measured as cash income, excluding food stamps and other in-kind food assistance.

[c] Single-question version of food sufficiency question (see footnote 12).

96 percent are classified as food secure. Among those saying they have "often not enough to eat, " 84 percent are classified as food insecure and 37 percent fall into the most severe category of food insecurity. [13]

In short, food security status is consistently related to income, to food expenditures, and to the single-item food sufficiency measure in the way that would be expected. There is no absolute measure of food security-no "gold standard" against which the status variable can be tested. Absent such a gold standard, the analysis in Exhibit 4-3 gives reasonable assurance that the measure is functioning as intended.

[13] The food insufficiency measure was applied in the CPS Supplement in two formats: a one-question version, which is reported here, and a two-question version. Each version was applied to a different portion of the CPS sample. A comparison of the food insecurity categories with the two-question version yields results very similar to those shown here (see the technical report for additional discussion).

CHAPTER FIVE

PREVALENCE OF FOOD INSECURITY AND HUNGER

The ultimate purpose of developing consistent national measures of food security is to provide information on how many American households are food secure, food insecure, and hungry. The measurement scale was used to produce estimates of the prevalence of household-level food insecurity and hunger for the 12-month time period ending on the date of the April 1995 CPS interview. The prevalence estimates for this 12-month period are shown in Exhibit 5-1.[1] Estimates are presented for each level of severity of the food security status variable by various household characteristics. Discussion of estimated prevalences for several population subgroups follows.

Prevalence Estimates

The four food security status categories shown in Exhibit 5-1 are mutually exclusive and exhaustive. Thus, to obtain the overall prevalence of food insecurity, aggregated over the three food insecurity status categories, the prevalences for the three categories must be summed. The overall prevalence of food insecurity among U.S. households, including all levels of severity, is 11.9 percent. This comprises 11.94 million of the approximately 100 million American households. The overall prevalence of food insecurity varies from a high of 19.5 percent among households with children under age 6 years, to a low of 5.9 percent among households with elderly members but no children. Households with children less than 18 years old comprise 56 percent of all households experiencing food insecurity, but only 38 percent of all households in the population.

Food Insecure without Hunger. The overall prevalence of food insecurity with no hunger, among all household types, is 7.8 percent, comprising 7.78 million households. Prevalence rates for this comparatively low severity range of food insecurity vary from 14.2 percent among households with children below age 6 years, to a low of 4.0 percent among

[1] Prevalence estimates for the 30-day time period ending on the date of the April 1995 CPS were also produced using a 30-day version of the scale. These estimates are presented and discussed in the companion volume of this report covering technical issues.

Exhibit 5-1

PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS

Numbers in thousands. Characteristic	Total	Food Secure[a]		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident[c]		Food Insecure, Severe Hunger Evident[d]	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Household Composition:									
All races:									
All households									
With children under 18 yrs	38,113	31,434	82.5	4,676.2	12.3	1,670.6	4.4	331.9	0.9
With children under 6 yrs	18,282	14,722	80.5	2,593.3	14.2	814.8	4.5	151.5	0.8
With elderly but no children	27,805	26,155	94.1	1,124.1	4.0	436.2	1.6	89.9	0.3
With no elderly or children	34,291	30,677	89.5	1,983.1	5.8	1,236.4	3.6	394.9	1.2
All household types	100,210	88,266	88.1	7,783.4	7.8	3,343.3	3.3	816.8	0.8
White:									
All households									
With children under 18 yrs	30,438	25,751	84.6	3,392.2	11.1	1,088.5	3.6	207.0	0.7
With children under 6 yrs	14,467	11,957	82.6	1,897.9	13.1	526.3	3.6	85.4	0.6
With elderly but no children	25,012	23,844	95.3	795.5	3.2	319.6	1.3	53.0	0.2
With no elderly or children	29,163	26,534	91.0	1,466.0	5.0	890.0	3.1	274.0	0.9
Black:									
All households									
With children under 18 yrs	5,841	4,195	71.8	1,054.0	18.1	496.2	8.5	95.5	1.6
With children under 6 yrs	2,826	1,980	70.1	556.3	19.7	249.0	8.8	40.8	1.4
With elderly but no children	2,321	1,896	81.7	292.0	12.6	99.7	4.3	32.5	1.4
With no elderly or children	3,852	3,013	78.2	433.4	11.2	299.5	7.8	105.8	2.8
Other:									
All households									
With children under 18 yrs	1,833	1,488	81.1	230.0	12.6	85.9	4.7	29.4	1.6
With children under 6 yrs	989	785	79.4	139.1	14.1	39.5	4.0	25.3	2.6
With elderly but no children	472	414	87.7	36.6	7.8	17.0	3.6	4.4	0.9
With no elderly or children	1,276	1,130	88.5	84.0	6.6	47.2	3.7	15.6	1.2
Hispanic:[f]									
All households									
With children under 18 yrs	4,475	3,116	69.6	966.5	21.6	334.6	7.5	58.4	1.3
With children under 6 yrs	2,539	1,697	66.8	599.2	23.6	200.2	7.0	42.4	1.7
With elderly but no children	1,151	910	79.1	174.9	15.2	46.0	4.0	20.0	1.7
With no elderly or children	2,075	1,699	81.9	218.8	10.5	120.4	5.8	37.2	1.8

Notes at end of exhibit

Exhibit **5-1** ***(continued)***

PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS
BY SELECTED CHARACTERISTICS OF HOUSEHOLDS

Numbers in thousands. Characteristic	Total	Food Secure"		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident'		Food Insecure, Severe Hunger Evident[d]	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percen of Tota
Household Income Category:[g]									
(All races and household types)									
Below $10,000	14,977	10,137	67.7	2,931.4	19.6	1,443	9.6	465.8	3.1
$10,000 - $19,999	16,717	13,403	80.2	2,206.1	13.2	904.0	5.4	203.4	1.2
$20,000 - $29,999	15,625	13,912	89.0	1,200.2	7.7	452.1	2.9	60.4	0.4
$30,000 - $39,999	12,149	11,391	93.8	561.0	4.6	174.4	1.4	20.5	0.2
$40,000 - $49,999	8,539	8,181	95.8	257.1	3.0	85.2	1.0	15.3	0.2
Above $50,000	22,370	22,079	98.7	207.1	0.9	79.6	0.4	5.0	0.01
Household Income-to-Poverty Ratio:[g]									
(All races and household types)									
Under 0.50	5,545	3,240	58.4	1,365.0	24.6	668.4	12.1	270.9	4.9
Under 1.00	15,808	10,230	64.7	3,500.7	22.1	1,587.6	10.0	489.5	3.1
Under 1.30	21,810	14,841	68.1	4,367.9	20.0	2,032.7	9.3	567.7	2.6
Under 1.85	35,115	25,914	73.8	5,952.6	17.0	2,568.0	7.3	680.4	1.9
1.85 and over	65,094	62,352	95.8	1,830.8	2.8	775.3	1.2	136.3	0.2
Household Relationship:									
(All races)									
Households with children under 18 yrs	38,113	31,434	82.5	4,676.2	12.3	1,670.6	4.4	331.9	0.9
Married couple families	26,841	23,750	88.5	2,348.3	8.8	617.9	2.3	124.5	0.5
Female head, no spouse	8,941	5,786	64.7	2,048.3	22.9	922.9	10.3	182.8	2.0
Male head, no spouse	2,332	1,898	81.4	279.5	12.0	129.8	5.6	24.5	1.0
Households with no children or elderly	34,291	30,677	89.5	1,983.1	5.8	1,236.4	3.6	394.9	1.2
Living alone	13,724	11,671	85.0	1,053.0	7.7	742.6	5.4	257.5	1.9
Households with elderly but no children	27,805	26,155	94.1	1,124.1	4.0	436.2	1.6	89.9	0.3
Living alone	11,699	10,737	91.8	638.1	5.5	266.6	2.3	57.2	0.5

Notes at end of exhibit

Exhibit 5-1 *(continued)*

PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS

Numbers in thousands. Characteristic	Total	Food Secure[a]		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident[c]		Food Insecure, Severe Hunger Evident[d]	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Area of Residence:[h]									
(AU races and household types)									
Inside Metropolitan areas	60,657	53,287	87.8	4,738.8	7.8	2,079.0	3.4	552.3	0.9
In central city	24,055	20,172	83.9	2,494.4	10.4	1,102.5	4.6	286.5	1.2
Not in central city	36,602	33,115	90.5	2,244.3	6.1	976.4	2.7	265.8	0.7
Outside Metropolitan areas	23,877	20,007	88.0	1,906.2	8.0	802.8	3.4	161.2	0.7
Census Geographic Region:									
(AU races and household types)									
Northeast	19,446	17,443	89.7	1,335.6	6.9	524.6	2.7	142.6	0.7
New England	4,946	4,486	90.7	308.8	6.2	110.6	2.2	41.3	0.8
Middle Atlantic	14,499	12,957	89.4	1,026.8	7.1	547.0	3.4	116.5	0.7
Midwest	23,623	21,113	89.4	1,614.6	6.8	743.9	3.2	150.9	0.6
East North Central	16,156	14,383	89.0	1,109.1	6.9	547.0	3.4	116.5	0.7
West North Central	7,466	6,730	90.1	505.5	6.8	196.9	2.6	34.4	0.5
south	35,800	31,311	87.5	2,959.2	8.3	1,244.6	3.5	285.5	0.8
South Atlantic	18,841	16,862	89.5	1,275.7	6.8	557.3	3.0	145.3	0.8
East South Central	6,586	5,659	85.9	592.5	9.0	267.3	4.1	67.3	1.0
West South Central	10,373	8,789	84.7	1,091.0	10.5	420.0	4.0	73.0	0.7
West	21,341	18,399	86.2	1,874.0	8.8	830.3	3.9	237.7	1.1
Pacific	15,348	13,119	85.5	1,444.1	9.4	613.6	4.0	171.3	1.1
Mountain	5,993	5,280	88.0	429.9	7.2	216.7	3.6	66.4	1.1

[a] ***No*** or minimal indicators of food insecurity evident.

[b] Multiple indicators of food insecurity, but no or minimal indicators of resource-constrained hunger evident for household members.

[c] Multiple indicators of resource-constrained hunger evident for adult household members.

[d] Multiple indicators of resource-constrained hunger evident for children in household and/or indicators of severe adult hunger.

[e] Elderly persons are defined as persons aged 60 years and older in this report.

[f] Persons of Hispanic etbnicity can be of any race.

[g] Income and poverty status refer to household income in a recent 12-month period, varying among rotation groups in the CPS sample. Income is missing for 9.8 percent of households but their income-to-poverty ratio category was imputed by the Census Bureau.

[h] For confidentiality reasons the CPS did not report the area of residence for 15.6 percent of households. The estimates shown are for households with area of residence identified.

households with elderly persons (age 60 years or over) but no children.* Generally, prevalence rates for food insecurity with no hunger are higher among households with young children (under age 6 years) than for all households with children.

Food Insecure with Moderate Hunger, The overall prevalence of food insecurity with moderate hunger evident, among all household types combined, is 3.3 percent, or 3.34 million households. The prevalence rates for this level of severity of food insecurity range from 4.5 percent among households with children under age 6 years, to 1.6 percent among households with elderly members but no children. Households with children of any age experienced higher levels of food insecurity with moderate hunger than did households without children, whereas households with young children experienced the highest rate.

Food Insecure with Severe Hunger. The overall prevalence of food insecurity with severe hunger (i. e . , with child hunger in households with children, and severe levels of adult hunger in households with or without children) is 0.8 percent when measured among all household types. This measured level of food insecurity is estimated to have occurred in 820,000 households during the 12 months prior to the survey. The pattern of distribution of households experiencing severe hunger is similar to that for the other food insecurity status levels, except that households with non-elderly adults and no children experienced the highest prevalence among household types. Overall, 1.2 percent (400,000) of all households of this type experienced food insecurity with severe hunger.

Overall Prevalence of Hunger. Combining the two most severe levels of food insecurity yields an overall estimate of food insecurity with either adult or child hunger. This procedure indicates that an estimated 4.1 percent of all households experienced some level of resource-constrained hunger during the year prior to the April 1995 CPS. Counting all household types, some 4.16 million households had either adults or children, or both, who experienced hunger due to inadequate resources sometime during the 12-month period preceding the survey. Examination of the hunger prevalence rate for each household type separately shows that hunger was experienced by a larger proportion of households with children (5.3 percent) than households without children, whereas a larger proportion of households with

[2] Note that households with elderly persons (age *60* and over) may also include younger adult members but do not include children.

neither children nor elderly members experienced hunger than did households with elderly members and no children.

Food Insecurity Prevalence by Race and Ethnic Origin. The household food insecurity prevalence estimates in Exhibit 5-l show differences across race and ethnic origin similar to those commonly seen in household income and poverty statistics.[3] Prevalences for each level of food insecurity are slightly lower among White households than for all races combined, whereas those for Black and Hispanic households are greater than for all races combined. Although the relative patterns of prevalences across household type within each race or ethnic group are similar, overall prevalences among Black and Hispanic households are about twice those for White households.[4]

The "other" category is comprised of Asian, Pacific Islanders, Alaska natives, Inuits, and other Native Americans. Overall, food insecurity prevalences among households in this subgroup are higher than those for White households, but lower than prevalences for either Black or Hispanic households. The one exception to this pattern is that the prevalence of severe hunger among households with children below age 6 years is higher in this subgroup (at 2.6 percent) than in any other racial or ethnic group.

Food Insecurity and Household Income. Examination of food insecurity prevalences across household income categories, and by ratio of household income to poverty, shows the influence of household financial resources on food security. Food insecurity prevalence rates, at all levels of severity, decline consistently as household income levels increase. As expected, food insecurity and hunger prevalence rates at all severity levels are highest among households with money income under 50 percent of the poverty threshold.

Overall, 41.6 percent of households with income below 50 percent of poverty experienced some level of food insecurity within the 12 months preceding the survey, and 17 percent of these households experienced food insecurity with either adult or child hunger. Examining the changes in prevalence of each level of severity of food insecurity across increasing ratios of income to poverty reveals large differences between households with incomes under 185 percent

[3] See, for example, U.S. Bureau of the Census, Current Population Reports, Series P60-189, ***Income, Poverty and Valuation of Noncash Benefits: 1994,*** U.S. Government Printing Office, Washington, DC, 1996.

[4] Note that Hispanic households may be either White or Black.

of poverty and households with income at or above 185 percent of poverty. The variation is less dramatic in comparing households across various levels of income below 185 percent of poverty, but food insecurity and hunger prevalences consistently increase as income declines.

That food insecurity increases as income falls is no surprise: because food insecurity is defined to include only conditions that result from financial resource constraints, it is expected that greater constraints mean more food insecurity. Nonetheless, it is important to note that food insecurity is not simply an alternative measure of poverty. Many households with below-poverty cash incomes apparently manage to avoid hunger, or even the less severe indications of food insecurity. Thus, food insecurity is a potential result of constrained financial resources, but not an inevitable result. How so many poor households avoid food insecurity is an important topic for future research.[5]

Food Insecurity and Household Relationship. Food insecurity prevalence rates reflect the greater degree of economic insecurity among single-parent families headed by women. The overall food insecurity prevalence rate (including all severity levels) for households with children headed by females with no spouse present is 35.3 percent, coincidentally the same rate as that for all households with incomes below 100 percent of poverty. Overall food insecurity prevalence rates among households with children headed by males with no spouse present are closer to those for all households in the population with children. The proportions of these households experiencing food insecurity with hunger, however, are somewhat higher than the rates for all households with children.

Concerns have been expressed regarding food insecurity among elderly persons living alone because the elderly experience more limitations in activities of daily living, are sometimes less mobile, and have more health problems than non-elderly people (Burt, 1993). These concerns are moderately supported by the prevalence estimates from the CPS data. The prevalence rates of all levels of food insecurity among households with elderly persons living alone are higher than for all households with elderly, but lower than those for all household types combined, or for households with no elderly or children (whether living alone or not).

[5] One line for such research, already underway at USDA, is to test alternative measures of income that include food stamp benefits and other forms of food assistance.

Living alone does appear to involve a slightly greater likelihood of the elderly experiencing each level of food insecurity.

Food Insecurity by Area of Residence. The distribution of overall household food insecurity across areas of residence (in central cities, in metropolitan areas but not central cities, outside metropolitan areas) follows a similar pattern as poverty. Overall food insecurity is highest in central cities, next highest in rural areas (outside metro areas), and lowest within suburbs (in metro areas, but not in central cities). Overall, 16.1 percent of central city households experienced some level of food insecurity during the year prior to the survey, whereas 5.8 percent experienced either adult or severe hunger.

Households in rural areas (outside metro areas) have nearly the same estimated prevalence of overall food insecurity and overall hunger as all households combined, whereas the estimated prevalences of overall food insecurity and hunger for suburban households are lowest, at 9.5 percent and 3.4 percent, respectively.

Food Insecurity by Geographic Region. In terms of broad geographic regions, the estimated prevalence of overall food insecurity is lowest in the northeast (10.3 percent), and highest in the west (13.8 percent). Estimated overall prevalence of hunger was also highest in the west, at 5.0 percent of households.

Within the larger regions there is variation in estimated food insecurity and hunger prevalence among smaller sub-regions. For example, estimated overall food insecurity prevalence varies from a low of 10.5 percent in the South Atlantic sub-region to a high of 15.3 percent in the West South Central sub-region. The estimated prevalence of overall hunger in these two sub-regions are 3.8 and 4.7 percent, respectively.

Participation in Food Assistance Programs

Food insecurity should be expected to have a complex relationship to households' participation in food assistance programs. Members of a household that is food insecure or hungry might logically seek food assistance-provided that someone in the household is aware of a program, is able and willing to apply, and meets the program's eligibility criteria. If the household then receives food assistance, the household's degree of food insecurity or hunger would presumably be reduced. Whether the assistance would eliminate the household's food insecurity and hunger entirely, or move the household into a more favorable food security status

category, would depend on the household's particular circumstances and the nature and amount of assistance it receives.

Given this complex relationship, simple tabulations can shed little light on the effectiveness of food programs in ameliorating food insecurity and hunger. Nonetheless, descriptive statistics on the proportion of households in the four food security status categories that participate in food programs provide a useful perspective on the behaviors of these populations. Exhibit 5-2 presents such statistics, indicating the percentage of households in each food security status category that received food assistance in the month before the interview.

Exhibit 5-2

PERCENT OF HOUSEHOLDS RECEIVING FOOD ASSISTANCE IN THE PAST 30 DAYS, BY FOOD SECURITY STATUS

Nature of Food Assistance Received in Past 30 Days	Food Secure	Food Insecure without Hunger	Food Insecure with Moderate Hunger	Food Insecure with Severe Hunger	All Households
Food stamps	4.4%	29.2%	32.1%	38.8%	7.5%
Free/reduced-price school lunch	4.3	25.2	26.4	22.1	6.8
Free/reduced-mice school breakfast	2.6	15.9	17.1	13.2	4.2
Free/reduced-price meals at day care or Head Start	0.9	5.8	5.9	6.2	1.5
WIC	2.0	10.6	9.4	5.8	2.9
Free/reduced-price meals for elderly	0.6	1.1	1.2	1.8	0.6
Food or vouchers from other program	0.3	1.4	2.1	3.9	0.5
Food assistance from any of the above programs	8.4	44.0	46.7	51.2	12.8
No food assistance from any of the programs	91.6	56.0	53.3	48.8	87.2

The figures show that a small fraction of food secure households received some form of assistance (8 percent). Among households reporting food insecurity or hunger at some level in the past 12 months, roughly half said they received some kind of food assistance in the most recent month. The data do not indicate whether or to what extent the assistance improved the

food security status of participating households. For non-participants, the data do not indicate whether they were ineligible, were unaware of the programs, or did not participate for other reasons.[6]

State-Level Food Security Prevalence Estimates

Overall state-level food insecurity prevalence estimates were produced from the CPS sample data. Because the primary sampling units for the CPS sample are defined within states, it is possible to derive state-level estimates. Users of these prevalence estimates, however, are strongly cautioned to make comparisons across states only with appropriate qualification, because sampling error can be large, especially for states with small populations. Generally, the estimates for the largest 10-12 states embody smaller sampling error than for the remaining states. The state-level estimates, along with standard errors, are listed in Appendix C to this report.

Thirty-Day Prevalence Estimates

Food insecurity prevalence estimates were derived for the two most severe levels of food insecurity from a scale referring to conditions experienced during the 30 days prior to the survey. The 30-day prevalence estimates are presented in the companion report covering technical issues.[7] Many of the same patterns in prevalence rates observed in the 12-month scale also emerge in the 30-day scale, although there are some differences.

Generally, larger proportions of households with children experienced food insecurity with either adult or child hunger within the 30 days preceding the survey than did households of other types. Households with elderly members but no children generally have the lowest prevalence rates on the 30-day scale, as in the 12-month case, whereas households with no elderly or children tend to have rates intermediate to other household groups. The 30-day food

[6] Program participation has typically been found to be under-reported in national household surveys. It is therefore likely that some households categorized as non-participants actually received assistance from one or more of the programs.

[7] The 30-day scale only measures food insecurity at the two most severe levels: food insecurity with moderate hunger, and food insecurity with severe hunger. Thus, the residual category for the 30-day scale is not "food secure," but more accurately interpreted as "no indication of hunger." There are no status categories comparable to "food secure" or "food insecure without hunger" in the 30-day scale.

insecurity prevalence rates appear generally to be approximately half to two-thirds the magnitude of the 12-month rates.

Estimating the Number of Persons in Food-Insecure Households

The Food Security Supplement is a household-level survey, with adult respondents providing information about the household. For most households, the questions in the Food Security Supplement do not allow accurate determination of the food security status of each individual in the household.[8] Within the conceptual framework guiding this research, it is possible that the experience of food insecurity and hunger is not uniformly experienced by all members of the household. Therefore, the prevalence estimates for different levels of severity of food insecurity shown above are household-level estimates only. It is not possible to produce exact estimates of true individual-level prevalences for food insecurity or hunger from the Food Security Supplement data.

It is possible, however, to estimate the number of persons living in the households whose food security status has been determined. These estimates are shown in Appendix E of this report. Readers are cautioned against treating these as estimates of true individual-level prevalences, however. Rather, they represent valid upper-bound estimates, or the maximum individual-level prevalences that would be estimated if all adults in each household shared the same food security status, and all children likewise had a common status. To the extent that food insecurity is not uniformly distributed among household members, these upper-bound figures will overestimate the true individual-level prevalences.

Comparing Food Security Prevalence Estimates from Various Sources

The prevalence estimates presented above result, first, from the LSRO/AIN conceptual definitions of food security, food insecurity, and hunger; second, from the operationalization of these concepts via the particular set of questions included in the April 1995 CPS Food Security Supplement; and third, from the scale development procedures used in this study. Because this particular combination of food security measurement concepts, data, and methods is

[8] This applies to households with more than one adult and/or one child. For single-person households, however, and households with one adult and one child, the household-level data also provide valid individual-level information.

implemented here for the first time, these prevalence estimates are not directly comparable with any of the diverse food security, food insecurity, or hunger prevalence estimates previously reported in the U.S. The present study is the first direct measurement undertaken from a national survey sample representative of the entire population and based on a large number of carefully-defined conditions of food insecurity and hunger across all levels of severity.

There are, therefore, no comparative benchmarks that enable one to say whether the estimates presented here indicate worsening or improvement of the U.S. food security situation relative to earlier estimates. The CPS Food Security Supplement, however, has been implemented again in September 1996 and April 1997, which will enable comparisons to be made on a consistent basis over time and assessment of year-to-year changes in the severity and extent of food insecurity and hunger in the U.S. Current plans are to seek implementation of the CPS Food Security Supplement on a continuing annual basis.

Although one cannot make valid direct comparisons of prevalence estimates from this study with those from other research, it may be instructive to note some of the previous estimates that have been reported. Burt and colleagues at the Urban Institute surveyed elderly persons (age 65 years or over) in 1992 using two slightly different surveys and. samples, and estimated that between 8 and 16 percent of elderly Americans experienced food insecurity in a six-month period. These proportions comprised between 2.5 million and 4.9 million food-insecure elderly persons (Burt, 1993, pp. xii and 39). Exhibit 5-l shows the estimated prevalence of household-level food insecurity (all levels combined) for households in which there are elderly persons (age 60 years or over) but no children, to be 5.9 percent. This proportion comprises 1.6 million food-insecure households with elderly members but no children. Of these, 526,000 are estimated to have experienced hunger among one or more household members sometime during the year.

Based on several implementations of the CCHIP survey, CCHIP researchers estimated in 1991 that 12 percent of all families with at least one child below age 12 years experienced hunger during the preceding year. An additional 16 percent of such families were estimated to be "at risk" of child hunger, a category approximating the "food insecure with moderate hunger" and "food insecure without hunger" categories in this study (Wehler, Scott and Anderson, 1991). In 1995, CCHIP researchers reported updated national estimates of child hunger prevalences using data from implementations of the CCHIP surveys in the period 1992-1994.

Based on results from these surveys, 19 percent of low-income families with at least one child under age 12 were estimated to be hungry (Wehler, Scott and Anderson, 1995a). The overall prevalence of food insecurity with moderate or severe hunger among households with children under age 18 (but including all income levels), based on the April 1995 Food Security Supplement scale, is 5.3 percent.

An additional comparison can be made with the estimated prevalence of ***food insufficiency,*** as indicated by responses to the USDA food sufficiency item in earlier national surveys.[9] Tabulations from the 1988-91 National Health and Nutrition Examination Survey (NHANES III) indicate that 3.9 percent of families in the overall U.S. population characterized the food eaten in their households as either "sometimes not enough" or "often not enough" to eat (DHHS, Third National Health and Nutrition Examination Survey, 1988-91). Among households with incomes below 131 percent of the federal poverty threshold, the combined proportion for these two categories was 12.9 percent. Similar tabulations from the 1989-91 Continuing Survey of Food Intakes by Individuals (CSFII) indicated that 9.1 percent of households with income below 131 percent of the poverty threshold characterized the food eaten in their households as "sometimes not enough" or "often not enough" to eat, on the basis of the USDA food sufficiency question (USDA, Continuing Survey of Food Intakes by Individuals, 1989-91).

The overall prevalence of households answering either "sometimes not enough" or "often not enough" to eat on the two versions of the food sufficiency question asked in the April 1995 Food Security Supplement to the CPS combined is 6.3 percent of all households in the population, comprising 6.3 million households. Among households reporting incomes less than or equal to 185 percent of the poverty threshold, 13.3 percent of respondents reported that the food eaten in their households was either "sometimes not enough" or "often not enough." Moreover, 92.9 percent of households at or below this income level that characterized their

[9] **The USDA food sufficiency question, first implemented in the 1977-78 USDA Nationwide Food Consumption** Survey, ask respondents, **"Which of the** following statements **best describes the food eaten in your household: (1) enough and the kind wanted** to eat; ***(2)*** enough, but not always **the** kind wanted to eat; **(3) sometimes not enough to eat; (4) often not enough to eat." The question addresses both a quality and a quantity dimension of the household food supply. For the NHANES III, the item was modified to ask about the quantitative dimension only.**

food as sometimes or often not enough also reported occasions within the previous 12 months when they did not have enough money for food.

Conclusion

Although the various prevalence estimates summarized above are not directly comparable with those derived from the April 1995 CPS Food Security Supplement data, they do indicate that the prevalences reported in Exhibit 5-l are broadly consistent with earlier estimates. When the varying degree of precision of conceptual and operational definitions, differing sample sixes and levels of sophistication of sampling strategies, and different scaling methods used in these studies are considered, the range of food insecurity, food insufficiency, and hunger prevalence estimates that results is perhaps more similar than might be expected. Given the differences in measures, samples, and measurement approaches used in the studies described, variation in prevalence estimates derived from them is to be expected. To the extent that the goals of building on these earlier measures, and improving and extending them through application of state-of-the-art survey design, sampling, and scaling methods, have been achieved in the current study, the food security and hunger prevalence estimates reported in Exhibit 5-l can be viewed as more complete and accurate in their representation of these phenomena in the U.S. population.

CHAPTER SIX

STRENGTHS AND LIMITATIONS OF THE FOOD SECURITY MEASURE

The Food Security Supplement and the scale development effort described in previous chapters are intended to provide policymakers and the research community with new tools for understanding the phenomenon of food insecurity and hunger in the United States. The results of this first round of survey and analysis are promising, suggesting that the tools will contribute to understanding an important dimension of American households' well-being.

Results of the Scaling Analysis

The analysis resulted in the creation of a unified food security scale, measuring the central dimension of food insecurity and hunger in the 12 months before the April 1995 interview. A secondary scale, focusing on the comparatively severe range of food insecurity with hunger, covers a 30-day period. The primary 12-month scale is expected to be broadly useful for policymakers and researchers monitoring community well-being.

The scaling analysis indicates that food insecurity and hunger can appropriately be viewed as a unidimensional phenomenon, with qualitatively distinct behaviors and conditions characterizing different levels of severity. The severity ranking of the questions in the scale supports the concept of food insecurity and hunger as a managed process of efforts to cope with food insufficiency. Questions concerning household anxiety about the food supply and adjustments to food management patterns are ranked at the less severe end of the scale. The middle range of the scale largely captures reductions in food intake for adults, whereas the most severe range contains indicators of reductions in children's food intake. Although this managed process can be best observed in households with children, tests indicate that a single version of the scale fits households with and without children equally well.

The food security scale meets standard requirements of reliability and validity. Statistical tests of reliability yielded good results. The scale has the expected relationship to other constructs: food security and hunger increase as income declines, as food expenditures **decline, and as food sufficiency (measured through independent questions) increases. Thus, the available evidence indicates that the scale performs as intended.**

Summary of Prevalence Estimates

During the **12** months ending in April 1995, 88.1 percent of the approximately 100 million households in the United States are estimated to have been food secure. The remaining 11.9 percent experienced some degree of food insecurity at some time during that year. This includes 7.8 percent who were food insecure without hunger, 3.3 percent who were food insecure with moderate hunger, and 0.8 percent who were food insecure with severe hunger, i.e., children's hunger, and/or severe adult hunger.

Some food insecurity and hunger is found in all parts of the nation and in all major population subgroups. As expected, however, food insecurity and hunger is particularly concentrated in subgroups that tend to have high rates of poverty, such as female-headed households and minority households.

Notes on Validity and Accuracy

Measures based on sample surveys always have two types of error: sampling error and non-sampling error. Sampling error refers to the fact that a randomly-drawn sample of a population will not always be perfectly representative of the population from which it is taken. The potential magnitude of this type of problem is estimated in the table of standard errors presented in Appendix D. Because the CPS sample is quite large, standard errors are small for prevalences estimated for the full population sample (less than half a percentage point for each of the food security status categories). Standard errors are larger for some of the smaller population and geographic subgroups, and particularly for smaller states.

Most types of non-sampling error cannot be directly estimated. One can only describe the types of error that might exist, given the study design, and speculate on their possible importance. The following comments therefore identify potential areas of error stemming from conceptual issues, non-response bias, and reporting errors.

Conceptual Limitations. The food security scale does not capture all dimensions of food security as spelled out in the LSRO definition, focusing instead on the central dimension of food sufficiency. This focus reflects the fact that the experience of hunger results strictly from inadequate *quantity* of food relative to need, largely independent of the source or nutritional quality of the food.

The food security scale does not capture the facet of food insecurity that is related to the lack of access to food through "socially acceptable" means, a facet explicitly incorporated in the LSRO definition. Although the Food Security Supplement included some questions pertinent to this dimension, they did not meet the statistical criteria for inclusion in the measurement scale. Additional households might be judged food insecure if the availability of food through socially acceptable means were fully considered. The number of such additional households would be quite small, however, based on analysis of the food resource augmentation questions included in the CPS data (see the companion Technical Report volume for estimates and discussion).

The food security scale also omits the dimensions of food safety and nutritional quality of household diets. Although a few questions refer to food quality, these represent households' subjective valuations of food, not the actual nutritional quality of diets as measured by nutritionists.[1] Some relationship presumably exists between food sufficiency and nutritional quality: for example, the LSRO definition indicates that, like hunger, "malnutrition is also a potential, although not necessary, consequence of food insecurity." The exact relationship between food insecurity, hunger, and the nutritional quality of household diets is an important area for future research.[2]

A final conceptual issue concerns the partitioning of the food security scale into ranges of relative severity to create the food security status measure. The ranges are grounded in different behavioral patterns that characterize different regions of the scale. The variation in behavioral patterns, however, occurs in somewhat different ways for different households, so any dividing line on the scale will probably classify some households at too severe a level of food insecurity, whereas others may be wrongly classified at an insufficiently severe level. The threshold questions, which are used to establish boundaries between the ranges, do not represent the least severe indicators of the behavior of interest, but the second or third such indicator in

[1] Recent research findings, however, show that individuals' perceptions of the nutritional quality of their own diets are apparently fairly accurate, as compared with the quality of their diets as assessed by nutritionists. (See, e.g., "Healthy Eating Index Score Compared to Individual's Self-Rating of Diet," Table 9 in ***The Healthy Eating Index,*** USDA, Center for Nutrition Policy and Promotion, October 1995.)

[2] See Chapter One, note 5 (page 8). See also the recent USDA Economic Research Service Staff Report, "Validation of a Self-Reported Measure of Household Food Insufficiency with Nutrient Intake Data" (Rose and Oliveira, 1997a).

the severity sequence. This procedure may weight the balance of erroneous classifications in the direction of placing households in a less severe status than their actual condition would warrant, if the underlying conceptual definitions are accepted as meaningful and appropriate.

Non-response Bias. Non-response bias may occur for two reasons. First, the CPS sample is defined on the basis of housing units. It therefore omits many homeless persons and families, who might be expected to have a particularly high prevalence of food insecurity and hunger. Second, some kinds of households are more difficult to find and interview than others, and these non-respondents might have either higher or lower than average prevalence of food insecurity and hunger.

The CPS has well-established, strong procedures for maximizing the representativeness of the sample, including procedures for weighting responses to compensate for potential non-response bias. Nonetheless, these procedures may not fully adjust for the likelihood that some types of non-respondents (especially homeless individuals and families) may have especially high rates of food insecurity. To the extent that this occurs, the study may underestimate the prevalence of food insecurity and hunger in the entire population.[3]

Reporting Error. Finally, three types of reporting error may exist. First, the Food Security Supplement included a screening logic that skipped the main battery of food insecurity and hunger questions for households not likely to be food insecure (for example, those with prior year incomes above 185 percent of the poverty level who reported no indications of food insufficiency). Screened-out households are classified as food secure, but it is possible that some would have been classified as food insecure if they had been asked the full battery of questions. Second, some households who respond to the full survey may systematically paint too positive or too negative a picture of their circumstances. Either type of bias is theoretically possible, but researchers familiar with past surveys believe that households more often under-report than over-report the severity of their condition. Third, households may simply respond erroneously to some questions, or interviewers may record the response incorrectly. This last sort of purely random error would be weighted in the direction of classifying households at a

[3] The Census Bureau has recently completed data collection under the National Survey of Homeless Service Providers and Clients (NSHSPC), sponsored by the Interagency Council on the Homeless. When these data are available for analysis, future household-based national prevalence estimates can be adjusted to make some allowance for food insecurity and hunger among homeless persons.

too-severe level of food insecurity.[4] Thus, two of the three possible types of reporting error would lead to underestimation of the prevalence of food insecurity, whereas the third would work in the opposite direction.[5]

Future Directions

The completed food security scale and the estimates of the prevalence of food insecurity and hunger mark the completion of one phase of the Food Security Measurement Project. FCS plans to continue sponsorship of the CPS Food Security Supplement on an annual basis. This will provide the basis for continuous monitoring of the level of food security, food insecurity, and hunger in the U.S population. Because the data collection and analysis methods will be consistent over time, policymakers will know whether, and by how much, conditions are improving or deteriorating, and be able to judge what new or different actions may be needed.

In the shorter term, several lines of activity are oriented toward enhancing the measurement tools. The battery of questions in the Food Security Supplement will be re-examined in the light of the analysis results to identify refinements that may make the survey more reliable or efficient. Subsets of questions will be identified, and scaling procedures specified, to allow more localized or specialized research efforts to measure food security in a way that will also be consistent and comparable to the CPS-based national benchmark measures. A variety of other analytic efforts will be undertaken to assess the quality of the data in the Food Security Supplement, to understand the relationship between the food security measure and related measures such as food expenditures or dietary intake, to explore the factors associated with food security, and to assess the impact of food assistance programs in ameliorating food insecurity and hunger.

[4] This occurs because the vast majority of households are food secure and the numbers decline at each successively severe level of food insecurity. Misclassifying a food secure household means that it will be considered food insecure, and the reverse is true for food insecure households. Thus, there are many more households with an opportunity to be misclassified as food insecure than with an opportunity to be misclassified food secure.

[5] A more thorough treatment of possible sources of error in the present estimates is presented in the companion Technical Report volume, Chapter Eight.

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APPENDIX A

SUPPLEMENT TO THE APRIL 1995 CURRENT POPULATION SURVEY

Supplement to the April 1995
Current Population Survey

2/27/95
FINAL

FOOD SECURITY QUESTIONNAIRE

I. FOOD SHOPPING

[IF MORE THAN ONE PERSON AGE 10 OR OVER, USE WORDING AFTER SLASH IN PARENTHETICAL. OTHERWISE USE WORDING BEFORE SLASH IN PARENTHETICAL.]

1. **The first few questions are about buying food for your household. Last week, did (you/anyone in your household) shop** for food at a supermarket or grocery store?

[ ] Yes **(ASK 1A)**
[ ] **No** (SKIP TO **1C**)
[ ] DK (SKIP TO **1C**)

1A. **How much did (you/your household) spend at supermarkets and grocery stores last week?**

$ _ _ _ .00 (ACCEPT RANGE)

[1 **DK**

Check if amount is within x and x, if not go to an interviewer, check screen. otherwise continue

[If household is **<185%** poverty, fill with **second option else fill with first option.]**

1A1. **Does this (amount) include ALL purchases (you/your household) made at supermarkets and grocery stores. whether paid for by cash. check. (or charge card?/charge card or food stamps?)**

[ ] **Yes (skip** to **1B)**
[ ] No (ask **1A2)**
[ ] Don't **Know (Skip to 1B)**

1A2. **What would the total amount be?**

$ _ _ _.00 (ACCEPT RANGE)

[ ] **DK**

Check if amount is within x and x, if not go to an interviewer check screen. otherwise continue

1B. How much of the (amount) was for nonfood items, such as cleaning or paper products?

$ _ _ _ .00 (ACCEPT RANGE)

[ ] DK

Check if amount is within x and x, if not go to an interviewer check screen, otherwise continue

[If answer to 1 is yes, fill the parentheticals accordingly.]

1C. How often (do/does) (you/someone from your household) USUALLY shop for food at a supermarket or grocery store--once a week or more, 2 to 3 times a month, (or once a month or less?/once a month or less>. (/or do you never shop at a supermarket or grocery store?)

[ ] Once a week or more (SKIP TO 2)
[ ] 2 to 3 times a month (ASK 1D)
[ ] (Or once a month or less/Once a month or less> (ASK 1D)
[ ] (/Never shop at a supermarket or grocery store) (SKIP TO 2)
[ ] DK (SKIP TO 2)

1D. How much (do/does> (you/your household) usually spend for food at supermarkets and grocery stores each MONTH?

$ _ _ _ .00 (ACCEPT RANGE)

[3 DK

Check if amount is within x and x. if not go to an interviewer check screen, otherwise continue

2. Last week. did (you/anyone in your household) buy food from any other kind of store such as a meat market. produce stand, bakery, warehouse or convenience store?

[ ] Yes (ASK 2A)
[ ] No (SKIP TO 3)
[ ] DK (SKIP TO 3)

2A. How much did (you/your household) spend for food at all such places last week?

$ _ _ _ .00 (ACCEPT RANGE)

[ ] DK

Check if amount is within x and x, if not go to an interviewer check screen. otherwise continue

[If household is <185% poverty, fill with second option else fill with first option.]

2A1. Does this (amount) include all purchases (you/your household) made at such places. whether paid for by cash, check. (or charge card?/charge card or food stamps?)

[ ] Yes (skip to 3)
[ ] No (ask 2A2)
[ ] Don't Know (Skip to 3)

2A2. What would the total amount be?

$ _ _ _.00 (ACCEPT RANGE)

[ ] DK

Check if amount is within x and X, if not go to an interviewer check screen, otherwise continue

3. Last week. did (you/anyone in your household) buy food at a restaurant. fast food place, cafeteria, or vending machine?

[ ] Yes (ASK 3A)
[ ] No (SKIP TO 4)
[ ] DK (SKIP TO 4)

3A. How much did (you/your household) spend for food at restaurants. fast food places. cafeterias, and vending machines 1 ast week?

$ _ _ _ .00 (ACCEPT RANGE)

[ ] DK

Check if amount is within X and x, if not go to an interviewer check screen, otherwise continue

[IF DK IN 1A, 2A. AND 3A SKIP TO CK9]
[ADD AMOUNTS IN 1A. 2A. 3A. 1A2. 2A2 AS NECESSARY THEN SUBTRACT AMOUNT IN 1B FROM TOTAL AND DISPLAY IN $]

4. Let's see, you've told me you (and other members of your household) spent a total of about $.____ 00 on all your food last week. Is that the right amount?.

[ ] Yes (SKIP TO 6)
[ ] No

5. What is the correct amount?

$ _ _ _ .00 (ACCEPT RANGE)

[ ] DK (Skip to CK9)

Check if amount is within x and x. if not go to an interviewer check screen, otherwise continue

6. **Is this the USUAL amount (you spend/your household spends) on food per week?**

[ ] Yes (Skip to CK9)
[ ] No
[] Varies
[ ] DK (Skip to CK9)

7. [If **household is 485% poverty, fill with second option else fill with first option.]**
About how much (do/does) (you/your household) usually spend? Remember to include all food purchases whether paid for by cash. check. (or charge card./charge card or food stamps.)

$ _ _ _ _.00 (ACCEPT RANGE)

[ ] DK

8. READ IF **NECESSARY:**
Is that weekly or monthly?

[ ] Weekly
[ ] Monthly

Check if amount is within x and x. if not go to an interviewer check screen, otherwi se **cont** i nue

---

CK9 If household is more than 185% poverty skip to 11. **Otherwise ask 9.**

---

9. **During the past 30 days. did (you/anyone in this household) get food stamps?**

[ ] Yes (ASK.9A)
[ ] No (SKIP TO 9B)
[ ] DK (SKIP TO 9B)

9A. **On what date did (you/your household) last receive your monthly food stamps?**

Month _ _

Day _ _

9A1. **How much did (you/your household) receive?**

$ _ _ _ .00

[3 DK

Check if amount is within x and x, if not go to an interviewer check screen. otherwise continue

[IF ANYONE IN HOUSEHOLD IS 60 YEARS OLD OR OLDER, ASK 9B. OTHERWISE SKIP TO 9C.]

9B During the past 30 days. did (you/anyone in the household receive free or reduced-cost meals for the elderly?

[ ] Yes
[ ] No
[ ] DK

[IF CHILDREN AGES 5 THROUGH 18. ASK 9C. OTHERWISE SKIP TO 9F.]

9C. During the past 30 days. did (NAME/any children in the household) receive free or reduced-cost lunches at school?

[3 Yes
[ ] No (Skip to 9E)
[ ] DK (Skip to 9E)

9D. During the past 30 days. did (NAME/any children in the household) receive free or reduced-cost breakfasts at school?

[ ] Yes
[ ] No
[ ] DK

[IF CHILDREN UNDER 13. ASK 9E. OTHERWISE SKIP TO 9F.]

9E. During the past 30 days. did (name/any children in the household) receive free or reduced-cost food at a day-care or Head Start program?

[ ] Yes
[ ] No
[ ] DK

[IF WOMEN AGES 15 TO 45 OR CHILDREN UNDER AGE 5 IN HOUSEHOLD. ASK 9F. OTHERWISE SKIP TO 9G.]
[IF CHILDREN UNDER AGE 5. FILL PARENTHETICAL.]

9F. During the past 30 days. did any (women/women or children/children) in this household get food through the WIC program?

[ ] Yes
[ ] No (skip to 9G)
[ ] DK (skip to 9G)

9F1. How many (women/women or children/children) in the household got WIC foods?

_ _ number

9G. During the past 30 days. did anyone in the household get food. or vouchers to buy food, from any other kind of program?

[ ] Yes (specify)_____
[ ] No
[ ] DK

NOTE: Will not renumber from this point because of time constraints. Would have to reprogram entire instrument and there is not sufficient time to test all the renumbering adequately.

I I. FOOD SUFFICIENCY

11CK If month-in-sample equals 8 then ask 11A else ask 11

11A These next questions are about the food eaten in your household.

Which of these statements best decribes the food eaten in your household--enough of the kinds of food you want to eat. enough but not always the kinds of food you want to eat. sometimes not enough to eat. or often not enough to eat?

[ ] Enough of the kinds of food we want to eat (skip to 15)
[ ] Enough but not always the kinds of food you want to eat (skip to 15)
[ ] Sometimes not enough to eat (skip to 13)
[ ] Often not enough to eat (skip to 13)

[ ] DK (skip to 15)

11. These next questions are about the food eaten in your household.

Which of the following statements best describes the amount of food eaten in your household--enough food to eat. sometimes not enough to eat, or often not enough to eat?

[ ] Enough food to eat
[ ] Sometimes not enough to eat (SKIP TO 13)
[ ] Often not enough to eat (SKIP TO 13)
[ ] DK (SKIP TO 15)

12. Do you have enough of the KINDS of food you want to eat, or do you have enough but NOT ALWAYS the KINDS of food you want to eat?

[ ] enough of the kinds you want (SKIP TO 15)
[ ] enough but not always the kinds you want (SKIP TO 15)
[ ] DK (SKIP TO 15)

13. Here are some reasons why people don't always have enough to eat. For each one, please tell me if that is a reason why YOU don't always have enough to eat.
[READ LIST. MARK ALL THAT APPLY.]

	ES	NO	DK
Not enough money for food		[ ]	Cl
Too hard to get to the store	[1	[ ]	Cl

No working stove	[ ]	[ ]	[ ]
No working refrigerator	[3	[ ]	[ ]
Not able to cook or eat because of health problems	[1	[ ]	[ ]

15. People do different things when they are running out of money for food in order to make their food or their food money go further.

In the last 12 months, since (date). did you ever run short of money and try to make your food or your food money go further?

[ ] Yes
[ ] No
[ ] DK

16. In the last 12 months, did you ever run out of the foods that you needed to make a meal and didn't have money to get more!

[ ] Yes
[ ] No
[ ] DK

CKALT If entry in 11A then go to CK17A else go to CK17

CK1/A

If household is less than 185% poverty.....(go to 17)
If household is more than 185% poverty and
A.) 11A=3, 4. D or R.....(go to 17)
B.) 16=1, D, or R.....(go to 17)
C.)11A=2 and 15=1, D or R.....(go to 17)
D.)11A=1.....(END)
E.) 11A=2 and 15=2.....(END)
All others.....(go to 17)

CK17

If household is less than 185% poverty.....(g o to 17)
If household is more than 185% poverty and
A.) 11=2, 3, D or R..... (go to 17)
B.) 16=1, D or R..... ..(g 0 to 17)
C.) 11=1 and 12=2, D or R and 15=1, D or R.....(go t o 17)
D.)11=1 and 12=1.....(END)
E.) 11=1 and 12=2, D or R and 15=2 .....(END)
All others..... (go to 17)

III. COPING MECHANISMS AND FOOD SCARCITY

[If 16=2 then skip to 18 else ask 17.]

17. Did this ever happen in the last 30 days?

[ ] Yes
[ ] No
[ ] DK

[IF MORE THAN ONE PERSON AGE 18 OR OVER IN HOUSEHOLD. FILL PARENTHETICAL REGARDING OTHER ADULTS IN HOUSEHOLD IN QUESTIONS 18 THROUGH 40:]

18. In the last 12 months. did you (or other adults in your household) ever get food or borrow money for food from friends or relatives?

[ ] Yes
[1 No
[ ] DK

19. [IF CHILDREN UNDER 18 IN HOUSEHOLD. ASK 19. OTHERWISE SKIP TO 20.] In the last 12 months. did you ever send or take (CHILD'S NAME/the children) to the homes of friends or relatives for a meal because you were running out of food?

[ ] Yes
[ ] No
[ ] DK

20. In the last 12 months. did you ever serve only a FEW KINDS of low-cost foods--like rice, beans, macaroni products. bread or potatoes--for SEVERAL DAYS in a row because you couldn't afford anything else?

[ ] Yes
[ ] No
[ ] DK

21. In the last 12 months. did (you/you or other adults in the household) ever put off paying a bill so that you would have money to buy food?

[ ] Yes
[ ] No
[3 DK

22. In the last 12 months. did you (or other adults in your household) ever get emergency food from a church, a food pantry. or food bank?

[3 Yes
[3 No
[1 DK

23. In the last 12 months. did you (or other adults in your household) ever eat any meals at a soup kitchen?

[ ] Yes
[ ] No
[ ] DK

24. In the last 12 months. since (date). did you (or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

[ ] Yes
[ ] No (SKIP TO 28)
[ ] DK (SKIP TO 28)

25. How often did this happen--almost every month. some months but not every month, or in only 1 or 2 months?

[ ] Almost every month
[ ] Some months but not every month
[ ] Only 1 or 2 months
[ ] DK

26. Now think about the last 30 days. Did you (or other adults in your household) ever cut the size of your meals or skip meals in the last 30 days because there wasn't enough money for food?

[ ] Yes
[ ] No (SKIP TO 28)
[ ] DK (SKIP TO 28)

27. In the last 30 days, how many days did this happen?

_____ days

[ ] DK

28. In the last 12 months. since (date). did you (or other adults in your household) ever not eat for a whole day because there wasn't enough money for food?

[1 Yes
[ ] No (SKIP TO 32)
[ ] DK (SKIP TO 32)

29. How often did this happen--almost every month. some months but not every month. or in only 1 or 2 months?

[ ] Almost every month
[ ] Some months but not every month
[ ] Only 1 or 2 months
[3 DK

30. Now think about the last 30 days. Did you (or other adults in your household) ever not eat for a whole day in the last 30 days because there wasn't enough money for food?

[ ] Yes
[ ] No (SKIP TO 32)
[ ] DK (SKIP TO 32)

31. In the last 30 days. how many times did this happen?

_____ times

[ ] DK

32. In the last 12 months. **did you ever eat less than you felt you should because there wasn't enough money to buy food?**

[ ] Yes
[ ] No (SKIP TO 35)
[ ] DK (SKIP TO 35)

33. **Did this happen in the last 30 days?**

[ ] Yes
[ ] No (SKIP TO 35)
[ ] DK (SKIP TO 35)

34. **In the last 30 days. how many days did you eat less than you felt you should because there wasn't enough money to buy food?**

___ number of days

35. **In the last 12 months, since (date), were you ever hungry but didn't** eat **because you couldn't afford enough food?**

[ ] Yes
[ ] No (SKIP TO 38)
[ ] DK (SKIP TO 38)

36. **Did this happen in the last 30 days?**

[ ] Yes
[ ] No (SKIP TO 38)
[ ] DK (SKIP TO 38)

37. **In the last 30 days. how many days were you hungry but didn't eat because you couldn't afford enough food?**

___ number of days

38. **Sometimes people lose weight because they don't have enough to eat. In the last 12 months. did you lose weight because there wasn't enough food?**

[ ] Yes
[ ] No (SKIP TO 40)
[ ] DK (SKIP TO 40)

39. **Did this happen in the last 30 days?**

[ ] Yes
[ ] No
[ ] DK

40. [IF CHILDREN UNDER 18 IN HOUSEHOLD. ASK 40. OTHERWISE SKIP TO 53.]
[IF ONLY ONE CHILD UNDER 18 IN HOUSEHOLD, FILL PARENTHETICAL WITH CHILD'S FIRST NAME.]
The next questions are about (children living in the household who are under 18 years old).

In the last 12 months. **since (date). did you ever cut the size of (NAME's/any of the children's) meals because there wasn't enough money for food?**

[ ] Yes
[ ] No (SKIP TO 43)
[ ] DK (SKIP TO 43)

41 **Did this ever- happen in the last 30 days?**

[ ] Yes
[ ] No (SKIP TO 43)
[ ] DK (SKIP TO 43)

42 In the last 30 days, how many days did you cut the size of (NAME's/the children's) meals because there wasn't enough money for food?

_____ days

[ ] DK

43. In the last 12 months. **since (date). did (NAME/any of the children) ever skip a meal because there wasn't enough money for.food?**

[ ] Yes
[ ] No (SKIP TO 47)
[ ] DK (SKIP TO 47)

44. **How often did this happen--almost every month, some months but not every month, or in only 1 or 2 months?**

[ ] Almost every month
[ ] Some months but not every month
[ ] Only 1 or 2 months
[ ] DK

45. **Now think about the last 30 days. Did (NAME/the children) ever skip a meal in the last 30 days because there wasn't enough money for food?**

[ ] Yes
[ ] No (SKIP TO 47)
[ ] DK (SKIP TO 47)

46. **In the last 30 days, how many days did this happen?**

_____ days

[3 DK

47 **In the last 12 months. (was CHILD'S NAME/were the children) ever hungry but you just couldn't afford more food?**

[ ] Yes
[ ] No (SKIP TO 50)
[ ] DK (SKIP TO 50)

48. **Did this ever happen in the last 30 days?**

[ ] Yes
[ ] No (SKIP TO 50)
[ ] DK (SKIP TO 50)

49. **In the last 30 days. how many days (was CHILD'S NAME/were the children) hungry but you just couldn't afford more food?**

___ number of days

50. **In the last 12 months. since (date). did (NAME/any of the children) ever not eat for a whole day because there wasn't enough money for food?**

[ ] Yes
[ ] No (SKIP TO 53)
[ ] DK (SKIP TO 53)

51. **Did this ever happen in the last 30 days?**

[ ] Yes
[ ] No (SKIP TO 53)
[ ] DK (SKIP TO 53)

52. **In the last 30 days. how many days did (NAME/the children) not eat for a whole day because there wasn't enough money for food?**

_____ days

[3 DK

IV. CONCERN ABOUT FOOD SUFFICIENCY

53. **[IF SINGLE ADULT IN HOUSEHOLD. USE "I" AND "my" IN PARENTHETICALS. OTHERWISE. USE "we' and "our".]**

Now I'm going to read you several statements that people have made about their food situation. For these statements. please tell me whether the statement was often, sometimes. or never true for you (or the other members of your household) in the last 12 months.

The first statement is "(I/We) worried whether (my/our) food would run out before (I/we) got money to buy more." Was that often. sometimes or never true for you in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true

54. "The food that (I/we) bought just didn't last. and (I/we) didn't have money to get more." Was that often. sometimes or never true for you in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true

55. "(I/we) couldn't afford to eat balanced meals." Was that often. sometimes or never true for you in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true

56. [IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK 56. OTHERWISE SKIP TD 59.] "(I/we) couldn't feed the children a balanced meal. because (I/we) couldn't afford that." Was that often, sometimes or never true for you in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true

57. "(Name was/The children were) not eating enough because (I/we) just couldn't afford enough food." Was that often. sometimes or never true for you in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true

58. "(I/we) relied on only a few kinds of'low-cost food to feed (name/the children) because (I was/we were) running out of money to buy food." Was that often, sometimes or never true for you in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true

END

APPENDIX B

QUESTIONS TESTED FOR THE FOOD SECURITY SCALES: UNWEIGHTED RESPONSE FREQUENCIES

Exhibit B-l

RESPONSES TO QUESTIONS TESTED FOR THE FOOD SECURITY SCALES
(Percent of Households in Category Responding Affiatively)

Questions (in order of decreasing severity or response rate)		Household Type			Household Income Relative to the Poverty Line				All Households
		Households without Children or Elderly Members	Households with Children	Households with Elderly Member(s), No Children	Below 50 Percent	Between 50 and 100 Percent	Bet ween 100 and 185 Percent	Above 185 Percent	
Number of Households (Unweighted)		15,273	16,954	12,503	2,240	4,451	8,971	29,068	44,730
Questions *Included in the 12-Month Scale*									
Q50	Child not eat for whole day	0.0%	0.2%	0.0%	0.6%	0.2%	0.1%	0.0%	0.1%
Q44	Child skipped meal, 3+ mos.	0.0	0.6	0.0	1.1	0.5	0.3	0.1	0.2
Q43	Child skipped meal	0.0	0.9	0.0	1.6	0.8	0.5	0.1	0.3
Q29	Adult not eat whole day, 3 +	1.5	1.3	0.4	5.7	3.2	1.5	0 . 3	1.1
Q47	Child hungry	0.0	1.8	0.0	4.0	1.9	0.9	0.1	0.7
Q28	Adult not eat whole day	2.1	2.0	0.5	7.9	4.2	2.2	0.5	1.6
Q40	Cut size of child's meals	0.0	2.1	0.0	4.7	2.3	0.9	0.2	0.8
Q38	Adult lost weight	2.3	2.1	0.9	7.5	5.0	2.7	0.6	1.8
Q35	Adult hungry but didn't eat	3.9	4.3	1.4	12.9	8.6	5.1	1.2	3.4
Q57	Child not eating enough	0.0	5.3	0.0	9.9	6.2	2.9	0.4	2.0
Q25	Adult cut/skipped meals, 3 +	5.5	6.4	2.5	19.1	13.5	7.3	1.8	5.0
Q32	Adult eat less than felt they	6.8	9.4	3.2	23.3	17.7	10.5	2.5	6.8
Q56	Couldn't feed child balanced	0.0	9.5	0.0	15.9	10.6	5.4	0.9	3.6
Q24	Adult cut size or skipped meals	7.7	9.5	3.2	24.7	17.6	11.0	2.8	7.1

Exhibit B-l *(continued)*

RESPONSES TO QUESTIONS TESTED FOR THE FOOD SECURITY SCALES

Questions (in order of decreasing severity or response rate)		Household Type			Household Income Relative to the Poverty Line				All Households
		Households without Children or Elderly Members	Households with Children	Households with Elderly Member(s), No Children	Below 50 Percent	Between 50 and 100 Percent	Between 100 and 185 Percent	Above 185 Percent	
Q58	Adult fed child few low-cost	0.0	14.8	0.0	23.9	15.1	8.9	1.6	5.6
Q55	Adult not eat balanced meals	11.1	15.1	7.0	39.3	31.2	18.5	4.0	11.5
Q54	Food bought didn't last	11.1	17.5	6.7	43.6	33.4	19.6	4.3	12.4
Q53	Worried food would run out	12.8	23.0	8.2	51.9	41.2	26.0	5.1	15.4
Resource Augmentation Questions									
Q23	Eat meals at soup kitchen	0.7	0.4	0.2	2.8	1.6	0.5	0.1	0.5
Q19	Children to other's home for	0.0	3.3	0.0	5.3	4.2	1.6	0.3	1.3
Q22	Get food from food pantry	2.1	4.7	1.6	15.5	10.7	3.4	0.5	3.0
Q21	Put off paying bill	9.9	20.8	4.5	33.7	29.9	22.5	5.0	12.5
Q 18	Get food or borrow from others	8.1	12.6	3.1	30.3	21.9	13.8	2.8	8.4
Other Questions Excluded from 12-Month Scale									
Q20	Serve few kinds of low-cost food	9.4	10.8	6.0	32.0	25.2	13.8	3.1	9.0
Q16	Run out of food, no money for	88.8	82.1	94.6	62.2	71.6	82.8	94.1	87.8
Q15	Short of money, make food go	72.5	59.3	83.5	41.1	49.7	61.1	79.1	70.5
Questions Included in the 30day scale									
Q52	Child not eat for whole day, 5+	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Q51	Child not eat for whole day	0.0	0.1	0.0	0.3	0.1	0.0	0.0	0.0
Q46	Child skipped a meal, 5+ days	0.0	0.2	0.0	0.5	0.1	0.1	0.0	0.1

Exhibit B-l *(continued)*

RESPONSES TO QUESTIONS TESTED FOR THE FOOD SECURITY SCALES

Questions (in order of **decreasing severity or response rate**)		Household Type			Household Income Relative to the Poverty Line				All Households
		Households without **Children or Elderly Members**	**Households with Children**	**Households with Elderly Member(s), No Children**	**Below 50 Percent**	**Between 50 and 100 Percent**	**Between 100 and 185 Percent**	**Above 185 Percent**	
Q31	Adult not eat whole day, 5 +	**0.4**	**0.3**	0.1	1.7	0.7	0.3	0.1	0.3
Q49	Child hungry, **5+** days	**0.0**	**0.3**	**0.0**	0.7	0.5	0.1	0.0	0.1
Q42	Cut child meal size, **5+** days	0.0	0.5	0.0	1.1	0.7	0.1	0.1	0.2
Q45	Child skipped meal	0.0	**0.5**	**0.0**	1.0	0.3	0.3	0.1	0.2
Q37	Adult hungry but didn't eat, **5+**	0.9	0.9	0.2	3.1	2.2	1.0	0.2	0.7
Q48	Child hungry	0.0	0.9	0.0	1.9	1.o	0.4	0.1	0.3
Q30	Adult not eat whole day	1.1	0.9	0.2	4.4	2.1	1.0	0.2	0.8
Q41	Cut child meal size	0.0	1.1	0.0	2.3	1.3	0.5	0.1	0.4
Q39	Adult lost weight	1.1	1.1	0.4	4.0	2.9	1.3	0.3	0.9
Q34	Adult eat less than should,	2.0	1.9	0.7	6.3	4.3	2.3	0.6	1.6
Q36	Adult hungry	2.0	2.1	0.7	6.7	4.4	2.6	0.5	1.7
Q27	Adult cut/skip meals, **5+** days	2.2	2.2	0.6	**7.2**	**4.6**	**2.6**	**0.6**	**1.8**
Q33	Adult eat less than felt they	3.6	4.4	1.5	**12.6**	**8.6**	**5.1**	**1.2**	**3.3**
Q26	Adults cut meal size or skip	4.4	4.8	1.8	**13.9**	**10.1**	**5.8**	**1.4**	**3.8**
Questions Excluded from 30-Day Scale									
Q17	I Run out of food, no **money** for	4.8	7.2	2.2	18.3	12.3	6.7	2.2	5.0

APPENDIX C

PREVALENCE ESTIMATES AND STANDARD ERRORS BY STATE

Exhibit C-l

ESTIMATED FOOD SECURITY PREVALENCES BY STATE:

Twelve Months Preceding the Survey

State	Total Households [in thousands]	Food Secure[a] (Percent)	Food Insecure, Hunger not Evident[b] (Percent)	Food Insecure, Moderate Hunger Evident[c] (Percent)	Food Insecure, Severe Hunger Evident[d] Percent)
US	100,210	88.1	7.8	3.3	0.8
AK	214	89.4	6.1	4.1	0.4
AL	1,773	87.1	8.2	3.4	1.2
AR	949	86.4	8.3	4.1	1.2
AZ	1,628	86.2	8.7	4.1	1.0
CA	11,400	85.6	9.6	3.8	1.0
CO	1.561	90.7	4.3	3.7	1.3
CT	1.280	90.2	6.2	2.2	1.4
DC	273	87.6	7.3	3.8	1.3
DE	261	90.7	5.1	3.4	0.7
FL	5.746	87.5	7.3	3.8	1.5
GA	2,744	90.2	7.1	2.3	0.3
HI	375	90.8	7.0	1.5	0.7
IA	1,093	91.4	6.5	1.9	0.2
ID	422	88.8	8.4	2.1	0.6
IL	4,426	88.2	7.3	3.8	0.8
IN	2,448	86.9	7.5	5.1	0.5
KS	998	88.8	7.2	3.1	0.9
KY	1,583	86.4	8.7	3.8	1.0
LA	1,475	84.4	10.6	4.2	0.8
MA	2,103	91.4	5.8	2.2	0.7
MD	1,936	94.9	2.0	2.9	0.2
ME	476	89.9	6.8	2.3	1.1
MI	3,284	88.8	6.9	3.4	1.0

Notes at end of exhibit

Exhibit C-l *(continued)*

ESTIMATED FOOD SECURITY PREVALENCES BY STATE:

Twelve Months Preceding the Survey

State	Total Households [in thousands]	Food Secure[a] (Percent)	Food Insecure, Hunger not Evident[b] (Percent)	Food Insecure, Moderate Hunger Evident[c] (Percent)	Food Insecure, Severe Hunger Evident[d] (Percent)
MN	1,920	91.2	5.9	2.4	0.6
MO	2,235	88.1	7.8	3.8	0.3
MS	993	82.8	10.3	6.0	0.9
MT	364	89.9	6.8	2.1	1.2
NC	2,792	89.1	8.1	2.4	0.4
ND	268	93.5	4.8	1.2	0.5
NE	658	91.6	6.9	1.1	0.4
NH	495	92.6	5.4	1.8	0.3
NJ	2,946	91.3	5.6	2.7	0.4
NM	615	83.3	10.6	4.1	1.9
NV	589	88.2	6.5	3.5	1.8
NY	6,714	87.8	8.1	3.3	0.8
OH	3,920	89.1	7.1	2.9	0.9
OK	1,243	84.4	11.1	3.9	0.7
OR	1,283	84.6	9.3	4.6	1.6
PA	4,840	90.4	6.6	2.3	0.6
RI	360	87.2	9.5	2.7	0.6
SC	1,513	91.0	6.4	2.0	0.6
SD	295	91.3	6.4	1.8	0.5
TN	2,238	86.0	9.2	3.8	0.9
TX	6,706	84.6	10.7	4.0	0.6
UT	618	89.3	7.3	3.2	0.2
VA	2,814	89.7	6.8	3.0	0.5
VT	232	90.0	6.1	3.4	0.5

Notes at end of exhibit

Exhibit C-l *(continued)*

ESTIMATED FOOD SECURITY PREVALENCES BY STATE:
Twelve Months Preceding the Survey

State	Total Households [in thousands]	Food Secure[a] (percent)	Food Insecure, Hunger not Evident[b] (Percent)	Food Insecure, Moderate Hunger Evident' (Percent)	Food Insecure, Severe Hunger Evident[d] (Percent)
WA	2,080	83.8	9.3	5.2	1.8
WI	2,078	93.6	4.8	1.4	0.2
WV	764	86.8	9.9	2.6	0.7
WY	197	89.2	6.3	4.4	0.2

a No or miniil indicators of food insecurity evident.

b Multiple indicators of food insecurity, but no or miniil indicators of resource-constrained hunger evident for household members.

c Multiple indicators of resource-constrained hunger evident' for adult household members.

d Multiple indicators of resource-constrained hunger evident for children in household and/or indicators of severe adult hunger.

Exhibit C-2

STANDARD ERRORS FOR STATE PREVALENCE ESTIMATES:

Twelve Months Preceding the Survey

State	Total Households in Sample	Food Secure[a] (Percent)	Food Insecure, Hunger not Evident[b] (Percent)	Food Insecure, Moderate Hunger Evident[c] (Percent)	Food Insecure, Severe Hunger Evident[d] (Percent)
US	44,647	0.36	0.30	0.09	0.07
AK	494	1.63	0.59	1.34	0.30
AL	644	1.16	1.23	0.62	0.31
AR	558	1.92	1.87	0.49	0.67
AZ	548	2.19	1.48	1.05	0.33
CA	3,099	0.91	0.90	0.46	0.19
CO	581	1.05	0.79	0.78	0.64
CT	394	1.59	0.79	0.93	1.39
DC	474	1.76	1.44	0.89	0.64
DE	343	3.29	2.18	1.37	0.53
FL	2,032	1.34	1.07	0.60	0.26
GA	1,110	1.55	1.75	0.53	0.12
HI	322	1.54	1.50	0.69	0.54
IA	555	1.62	1.67	0.39	0.17
ID	574	2.22	2.14	0.68	0.37
IL	1,832	0.58	0.87	0.44	0.21
IN	506	2.30	1.69	0.98	0.34
KS	572	1.97	1.83	0.67	0.49
KY	574	0.96	0.63	0.69	0.53
LA	479	2.21	1.90	0.72	0.37
MA	1,680	0.76	0.56	0.32	0.22
MD	461	0.54	0.46	0.52	0.23
ME	435	1.23	1.19	0.87	0.57
MI	1,798	0.52	0.66	0.55	0.25

Notes at end of exhibit

Exhibit C-2 *(continued)*

STANDARD ERRORS FOR STATE PREVALENCE ESTIMATES:
Twelve Months Preceding the Survey

State	Total Households in Sample	Food Secure[a] (Percent)	Food Insecure, Hunger not Evident[b] (Percent)	Food Insecure, Moderate Hunger Evident' (Percent)	Food Insecure, Severe Hunger Evident[d] (Percent)
MN	620	1.48	1.30	0.63	0.27
MO	487	2.13	1.67	0.71	0.21
MS	527	2.23	1.46	1.67	0.49
MT	643	2.10	1.13	0.97	0.45
NC	1,764	0.66	0.67	0.44	0.17
ND	630	1.10	0.91	0.41	0.36
NE	620	0.81	0.81	0.53	0.32
NH	398	1.33	1.67	0.56	0.27
NJ	1,767	0.88	0.51	0.43	0.14
NM	529	1.52	1.19	0.73	0.60
NV	474	1.82	1.36	0.68	0.74
NY	2,751	0.85	0.75	0.41	0.22
OH	1,804	0.82	0.70	0.64	0.23
OK	634	1.54	1.01	0.85	0.37
OR	516	1.70	1.10	0.64	0.54
PA	2,097	0.34	0.47	0.33	0.23
RI	387	1.66	1.32	0.96	0.38
SC	502	1.91	1.86	0.79	0.33
SD	655	1.32	0.87	0.52	0.29
TN	552	2.49	1.66	1.33	0.64
TX	1,809	0.87	0.76	0.41	0.19
UT	499	1.56	0.86	0.57	0.19
VA	1,173	0.95	0.75	0.72	0.29
VT	399	1.08	1.49	1.13	0.34

Notes at end of exhibit

Exhibit C-2 *(continued)*

STANDARD ERRORS FOR STATE PREVALENCE ESTIMATES:
Twelve Months Preceding the Survey

State	Total Households in Sample	Food Secure[a] (Percent)	Food Insecure, Hunger not Evident[b] (Percent)	Food Insecure, Moderate Hunger Evident[c] (Percent)	Food Insecure, Severe Hunger Evident[d] (Percent)
WA	544	1.99	1.46	0.89	0.78
WI	626	0.85	0.77	0.44	0.20
WV	629	1.82	1.11	0.60	0.38
WY	546	2.99	1.49	1.94	0.16

a No or minimal indicators of food insecurity evident.

b Multiple indicators of food insecurity, but no or minimal indicators of resourceconstrained hunger evident for household members.

c Multiple indicators of resource-constrained hunger evident for adult household members.

d Multiple indicators of resource-constrained hunger evident for children in household and/or indicators of severe adult hunger.

APPENDIX D

ESTIMATED STANDARD ERRORS FOR PREVALENCE TABLES IN CHAPTER FIVE

Exhibit D-l

STANDARD ERRORS: PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS: 12-MONTH SCALE

Characteristic	Sample Size (in ones)	Food Secure[a]		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident[c]		Food Insecure, Severe Hunger Evident[d]	
		Number (1000s)	Percentage Points	Number (1000s)	Percentage Points	Number (1000s)	Percentage Points	Number (1000s)	Percentage Points
Household Composition:									
All *races:*									
With children under 18 yrs	16,914	223	0.59	195	0.51	63	0.17	34	0.09
With children under 6 yrs	7,934	173	0.95	144	0.79	44	0.24	37	0.20
With elderly; no children	12,485	115	0.41	95	0.34	35	0.13	20	0.07
With no elderly or child	15,248	132	0.38	80	0.23	52	0.15	56	0.16
All household types	44,647	356	0.36	295	0.30	86	0.09	74	0.07
White:									
With children under 18 yrs	13,808	129	0.43	123	0.40	77	0.25	25	0.08
With children under 6 yrs	6,391	116	0.81	116	0.80	45	0.31	24	0.16
With elderly; no children	11,283	88	0.35	71	0.28	29	0.12	11	0.05
With no elderly or child	13,137	75	0.26	86	0.30	50	0.17	39	0.13
Black:									
With children under 18 yrs	2,023	76	1.31	74	1.27	19	0.33	13	0.22
With children under 6 yrs	959	49	1.74	33	1.15	21	0.73	15	0.52
With elderly: no children	926	40	1.71	35	1.50	9	0.39	10	0.41
With no elderly or child	1,370	50	1.29	34	0.88	33	0.87	22	0.58
Other:									
With children under 18 yrs	1,083	32	1.74	26	1.41	16	0.88	5	0.29
With children under 6 yrs	584	22	2.26	17	1.71	9	0.96	6	0.65
With elderly; no children	276	13	2.71	10	2.10	7	1.50	3	0.55
With no elderly or child	741	28	2.18	16	1.22	14	1.08	7	0.56
Hispanic:									
With children under 18 yrs	1,529	84	1.87	97	2.16	46	1.02	16	0.36
With children under 6 yrs	857	65	2.55	73	2.88	35	1.39	15	0.58
With elderly; no children	406	36	3.16	29	2.49	13	1.16	11	0.94
With no elderly or child	695	53	2.56	59	2.86	17	0.80	12	0.56

Notes at end of exhibit

Exhibit D-l *(continued)*

STANDARD ERRORS: PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS: 12-MONTH SCALE

Characteristic	Sample Size (in ones)	Food Secure[a]		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident[c]		Food Insecure, Severe Hunger Evident[d]	
		Number (1000s)	Percentage Points	Number (1000s)	Percentage Points	Number (1000s)	Percentage Points	Number (1000s)	Percentage Points
Household Income Category?									
(All *races and household types)*									
Below $10,000	6,368	105	0.70	10	0.67	41	0.27	57	0.38
$10,000 - $19,999	7,651	158	0.95	12	0.70	74	0.44	24	0.14
$20,000 - $29,999	7,202	92	0.59	60	0.38	61	0.39	15	0.09
$30,000 to $39,999	5,808	49	0.40	37	0.30	17	0.14	6	0.05
$40,000 - $49,999	4,037	20	0.24	22	0.25	18	0.22	6	0.07
Above $50,000	10,690	43	0.19	29	0.13	19	0.08	21	0.01
Household Income-to-Poverty Ratio:[c]									
(AU *races and 'household types)*									
Under 0.50	2,219	86	1.55	82	1.48	40	0.71	33	0.59
Under 1 .OO	6,650	130	0.82	127	0.80	35	0.22	64	0.41
Under 1.30	9,384	176	0.81	159	0.73	42	0.19	68	0.31
Under 1.85	15,594	263	0.75	218	0.62	68	0.19	68	0.19
1.85 and over	29,053	92	0.14	78	0.12	40	0.06	21	0.03
Household Relationship:									
(All races)									
Households with children under 18 yrs	16,914	223	0.59	195	0.51	63	0.17	34	0.09
Married couple families	12,295	103	0.38	97	0.36	62	0.23	12	0.05
Female head, no spouse	3,677	93	1.04	77	0.87	59	0.66	28	0.32
Male head, no spouse	942	30	1.30	23	1.00	20	0.88	6	0.28
Households with no children or elderly	15,248	132	0.38	80	0.23	52	0.15	56	0.16
Living alone	5,941	93	0.67	47	0.34	35 56	0.41	39	0.29
Households with elderly but no children	12,485	115	0.41	95	0.34		0.13	20	0.07
Living alone	5,222	90	0.77	76	0.65	31	0.27	21	0.18

Notes at end of exhibit

Exhibit D-l *(continued)*

STANDARD ERRORS: PREVALENCE OF HOUSEHOLD FOOD SECURITY STATUS BY SELECTED CHARACTERISTICS OF HOUSEHOLDS: 12-MONTH SCALE

Characteristic	Sample Size (in ones)	Food Secure[a]		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident[c]		Food Insecure, Severe Hunger Evident[d]	
		Number (1000s)	Percent-age Points	Number (1000s)	Percent-age Points	Number (1000s)	Percent-age Points	Number (1000s)	Percent-age Points
Area of Residence: (AU *races and household types)*									
Inside Metropolitan areas	24,214	286	0.47	230	0.38	73	0.12	58	0.10
In central city	9,606	169	0.70	129	0.53	49	0.20	48	0.20
Not in central city	14,608	165	0.45	132	0.36	41	0.11	28	0.08
Outside Metropolitan areas	12,532	97	0.41	72	0.30	41	0.17	23	0.10
Census Geographic Region: (All *races and household types)*									
Northeast	10,308	76	0.39	62	0.32	35	0.18	23	0.12
New England	3,693	16	0.33	14	0.28	11	0.22	15	0.31
Middle Atlantic	6,615	68	0.47	63	0.43	27	0.18	21	0.14
Midwest	10,705	158	0.67	124	0.52	57	0.24	26	0.11
East North Central	6,566	95	0.59	77	0.48	54	0.34	23	0.14
West North Central	4,139	68	0.91	57	0.76	22	0.29	12	0.15
South	14.265	142	0.40	109	0.30	41	0.11	26	0.07
South Atlantic	8,488	81	0.43	63	0.34	34	0.18	15	0.08
East South Central	2,297	76	1.16	60	0.92	28	0.42	16	0.25
West South Central	3,480	80	0.77	65	0.63	22	0.21	20	0.20
West	9,369	111	0.52	109	0.51	68	0.32	34	0.16
Pacific	4,975	123	0.80	124	0.81	63	0.41	33	0.22
Mountain	4,394	33	0.54	25	0.41	23	0.38	11	0.19

[a] No or minimal indicators of food insecurity evident.

[b] Multiple indicators of food insecurity, but no or minimal indicators of resource-constrained hunger evident for household members.

[c] Multiple indicators of resource-constrained hunger evident for adult household members.

[d] Multiple indicators of resource-constrained hunger evident for children in household and/or indicators of severe adult hunger.

[e] Income and poverty status refers to household income in preceding 12 months.

APPENDIX E

DISTRIBUTION OF PERSONS IN HOUSEHOLDS BY FOOD SECURITY STATUS CLASSIFICATION

Exhibit E-l

ESTIMATED NUMBERS AND PROPORTIONS OF PERSONS WITH SELECTED CHARACTERISTICS LIVING IN HOUSEHOLDS WITH EACH FOOD SECURITY STATUS: 12-MONTH SCALE

Characteristic[a]	Total (1000s)	Food Secure		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident		Food Insecure, Severe Hunger Evident[c]	
		Number (1000s)	Percent	Number (1000s)	Percent	Number (1000s)	Percent	Number (1000s)	Percent
Age:									
All *races:*									
Children under age 6	24,410	19,460	79.7	3,599	14.7	1.137	4.7	215	0.9
Children under age 18	70,160	56,480	80.5	9,427	13.4	3,570	5.1	692	1.0
Adults age 18 to 59	148,900	130,400	87.6	12,380	8.3	4,997	3.4	1,168	0.8
Adults age 60 or older	41,650	39,190	94.1	1,686	4.1	638	1.5	128	0.3
All people	260,170	226,000	86.7	23,490	9.0	9,205	3.5	1,987	0.8
White:									
Children under age 6	19,170	15.720	82.0	2,621	13.7	697	3.6	130	0.7
Children under age 18	55,480	46,070	83.1	6,703	12.1	2,263	4.1	439	0.8
Adults age 18 to 59	123,900	110,500	89.1	9,192	7.4	3,432	2.8	835	0.7
Adults age 60 or older	37,050	35,360	95.4	1,171	3.2	451	1.2	69	0.2
Black:									
Children under age 6	3,969	2,749	69.3	790	19.9	387	9.8	44	1.1
Children under age 18	11,200	7,714	68.9	2,217	19.8	1,083	9.7	188	1.7
Adults age 18 to 59	18.250	14.150	77.5	2,557	14.0	1,278	7.0	266	1.5
Adults age 60 or older	3,670	3,010	82.0	448	12.2	157	4.3	54	1.5
Other:									
Children under age 6	134	go	59.4	32	24.0	14	10.3	8	6.3
Children under age 18	457	279	61.2	90	19.7	74	16.1	14	3.0
Adults age 18 to 59	770	559	72.6	103	13.4	86	11.2	22	2.8
Adults age 60 or older	122	104	84.9	13	11.0	3	2.3	2	1.9
Hispanic:									
Children under age 6	3,714	2,388	64.3	928	25.0	323	8.7	75	2.0
Children under age 18	9,715	6,327	65.1	2,354	24.2	879	9.1	154	1.6
Adults age 18 to 59	15,420	11,560	75.0	2,655	17.2	1.037	6.7	170	1.1
Adults age 60 or older	2,099	1,653	78.7	320	15.2	100	4.8	27	1.3

Notes at end of exhibit

Exhibit E-l *(continued)*

ESTIMATED NUMBERS AND PROPORTIONS OF PERSONS WITH SELECTED CHARACTERISTICS LIVING IN HOUSEHOLDS WITH EACH FOOD SECURITY STATUS: 12-MONTH SCALE

Characteristic[a]	Total (1000s)	Food Secure		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident		Food Insecure, Severe Hunger Evident[c]	
		Number (1000s)	Percent	Number (1000s)	Percent	Number (1000s)	Percent	Number (1000s)	Percent
Household Income Category:[d]									
(AU *races and household types)*									
Below $10,000	31,450	19,670	62.6	7,237	23.0	3,527	11.2	1,010	3.2
$10,000 - $19,999	38,750	28,830	74.4	6,745	17.4	2,615	6.8	563	1.5
$20,000 - $29.999	39,180	33,430	85.3	4,197	10.7	1,402	3.6	157	0.4
$30,000 to $39,999	33,140	30,320	91.5	2,132	6.4	609	1.8	71	0.2
$40,000 - $49,999	25,120	23,740	94.5	1,028	4.1	322	1.3	35	0.1
Above $50,000	70,430	69,320	98.4	813	1.2	274	0.4	27	0.0[e]
Household Income-to-Poverty Ratio:[d]									
(AU *races and household types)*									
Under 0.50	17,220	9,733	56.5	4,524	26.3	2,196	12.8	770	4.5
Under 1 .00	43,860	27,030	61.6	10,820	24.7	4,753	10.8	1,249	2.8
Under 1.30	58,820	37,990	64.6	13,410	22.8	5,984	10.2	1,431	2.4
Under 1.85	94,440	67,040	71.0	18,330	19.4	7,400	7.8	1,672	1.8
1.85 and over	166,300	159,000	95.6	5,168	3.1	1,805	1.1	314	0.2
Household Relationship:									
(All *races)*									
Households with children under 18 yrs	150,200	123,800	82.4	18,470	12.3	6,619	4.4	1,266	0.8
Married couple families	112,700	98,600	87.5	10,540	9.4	2,967	2.6	619	0.6
Children < age 18	50,740	43,950	86.6	4,990	9.8	1,482	2.9	318	0.6
Female head, no spouse	29,690	19,030	64.1	6,908	23.3	3,177	10.7	578	2.0
Children < age 18	15,940	9,774	61.3	3,938	24.7	1,876	11.8	347	2.2
Male head, no spouse	7,752	6,184	79.8	1,023	13.2	475	6.1	69	0.9
Children < age 18	3,491	2,754	78.9	499	14.3	212	6.1	27	0.8
Households with no children or elderly	62,290	56,560	90.8	3,233	5.2	1,905	3.1	584	0.9
Living alone	13,720	11,670	85.0	1,053	7.7	743	5.4	258	1.9
Households with elderly but no children	48,260	45,650	94.6	1,792	3.7	681	1.4	136	0.3
Living alone	**11,700**	**10,740**	**91.8**	**638**	**5.5**	**267**	**2.3**	**57**	**0.5**

Notes at end of exhibit

Exhibit E-l *(continued)*

ESTIMATED NUMBERS AND PROPORTIONS OF PERSONS WITH SELECTED CHARACTERISTICS **LIVING** IN HOUSEHOLDS WITH EACH FOOD SECURITY STATUS: **12-MONTH** SCALE

Characteristic[a]	Total (1000s)	Food Secure		Food Insecure, Hunger not Evident[b]		Food Insecure, Moderate Hunger Evident		Food Insecure, Severe Hunger Evident[c]	
		Number (1000s)	Percent	Number (1000s)	Percent	Number (1000s)	Percent	Number (1000s)	Percent
Area of Residence:'									
(AU *races* and household types)									
Inside metropolitan areas	158,300	136,830	86.4	14.492	9.2	5,581	3.5	1.392	0.9
In central city	59,760	48,830	81.7	7,457	12.5	2,791	4.7	680	1.1
Not in central city	98,540	88,000	89.3	7,035	7.1	2,790	2.8	712	0.7
Outside metropolitan areas	62,149	53,720	86.4	5,742	9.2	2,319	3.7	357	0.6
Census **Geographic Region:**									
(AU *races* and household *types)*									
Northeast	50,150	44,660	89.1	3,852	7.7	1.307	2.6	323	0.6
New England	12,520	11,340	90.6	820	6.6	278	2.2	76	0.6
Middle Atlantic	37,630	33,320	88.6	3,032	8.1	1,029	2.7	248	0.7
Midwest	61,180	54,220	88.6	4,774	7.8	1,827	3.0	357	0.6
East North Central	42.130	37.220	88.4	3,295	7.8	1,326	3.2	289	0.7
West North Central	19,050	17,000	89.2	1,479	7.8	501	2.6	68	0.4
South	92,750	79,590	85.8	8,848	9.5	3,622	3.9	684	0.7
South Atlantic	48,040	42,390	88.2	3,819	8.0	1,470	3.1	358	0.7
East South Central	16,760	14,200	84.7	1,682	10.0	735	4.4	**142**	0.9
West South Central	27,950	23,009	82.3	3,347	12.0	1,418	5.1	184	0.7
West	56,640	47,550	84.0	6,020	10.6	2,449	4.3	623	1.1
Pacific	40,980	34,050	83.1	4,655	11.4	1,809	4.4	469	1.1
Mountain	15,650	13,509	86.2	1,365	8.7	640	4.1	154	1.0

[a] Some numbers may not sum to totals due to **rounding.**

[b] Hunger evident at moderate levels for adults in household.

[c] Hunger evident for children and at more severe levels for adults in ousehold.

[d] **Income** and poverty status refer to household income and status in the precedii year.

[e] Too few cases **to** provide a meaningful estimate

[f] Area of residence is not identified for between 12-16 percent of persons in each food security category.

APPENDIX F

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6879

Household Food Security in the United States in 1995
Summary Report